THE LEVERHULME TRUST

The West Africa Commission 1938-1939

Technical Reports

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GENERAL INTRODUCTION BY COLONEL SANDEMAN ALLEN, O.B.E., M.C., T.D., M.P., C. G. AMMON, M.P., E. CLEMENT DAVIES, K.C., M.P., AND DR. L. HADEN GUEST, M.C., M.P.

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1943

Printed for the Trustees by Waterlow & Sons Limited, London

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REPORT OF THE WEST AFRICA COMMISSION

GENERAL INTRODUCTION

1. In the spring of 1938 the Trustees of the Leverhulme Trust invited four members of Parliament to go out to West Africa to study and report upon conditions there as set out in the following Terms of Reference :

> To investigate, study and report on the West African Colonies generally ; the inter-relationship between the Government, its officials, the traders and the natives ; the status and standard of life of the native population and improvement thereof ; the production of food and other materials and the increase thereof ; and, in particular, certain main problems in respect of the development of agricultural, pastoral and forestry resources.

2. The matters to be considered included the problem of the improvement of the agricultural and pastoral farming of the native farmers and the introduction of new crops ; the study of export crops, forestry, animal husbandry ; and the general problem of soil conditions and erosion and improvement by better cultivation. Lastly, there was the problem of the present system of land tenure and its effect on agricultural development with a view to indicating what system is likely to be the most advantageous for the fullest development of the inhabitants and the land.

3. Dr. L. Haden Guest, M.C., M.P., was asked to undertake the preliminary arrangements, and three other M.P.'s accepted the Trustees' invitation to undertake the investigation. These M.P.'s are Mr. C. G. Ammon, M.P., Mr. E. Clement Davies, K.C., M.P., and Colonel Sandeman Allen, O.B.E., M.C., T.D., M.P.

4. The technical experts who accepted appointment were :

E. M. Crowther, D.Sc., F.I.C. (Head of Chemistry Department, Rothamsted Experimental Station, Harpenden, Herts).

Lt.-Col. A. G. Doherty, M.C., M.R.C.V.S. (Secretary, Royal Zoological Society of Ireland, Dublin).

H. C. Sampson, B.Sc., C.I.E. (Economic Botanist, Kew, Surrey).

E. P. Haslam, M.A. (N.Z.), B.A. (Oxon) and Rhodes Scholar, was appointed in the joint capacity of Economic Adviser and Secretary.

5. The members of the West Africa Commission left Liverpool on the Motor Vessel *Apapa* on 19th October 1938 and left West Africa in the early months of 1939, the last members of the Commission to return arriving in England on 20th February 1939. During this time a tour of Nigeria was made extending over some thousands of miles and over a period of about two months. In addition to this, visits were paid to the British Mandated Territory of the Cameroons, to the French Cameroons, to the Colony and Protectorate of the Gold Coast, to Sierra Leone, and to the Gambia. In passing from Nigeria to the Gold Coast a journey was made by car through Dahomey and French and British Togoland. Some members of the Commission also visited other parts of French West Africa, travelling from the Gold Coast to the River Niger at Segou and thence to Dakar.

6. The main general conclusions can be stated comparatively shortly. British West Africa is a vast territory wholly within the tropics, with a population of about 25 million people (20 million of whom are in Nigeria) and with immense natural resources, vegetable, animal and mineral. The standard of life of the African population, while not a high one, is sufficiently good to provide a solid economic foundation of life for the masses of the people, and is capable of great improvement by technical changes in the methods of African farming. What is most striking is that on the basis of this African system of farming West Africa has been for many hundreds of years self-sufficient in all essential commodities, and remains self-sufficient to-day.

7. The social system in Great Britain and the social system in West Africa are very different. The main differences between these two social systems are not only that the agricultural and craft industries in West Africa embrace the whole people, but that the basis of these industries is farming for subsistence on land held on a communal tenure and not farming for sale and profit on land held on individual tenure. This means that all Africans are, to a very large extent, and very many of them wholly, outside the system of money economy which dominates the economic life of Europe and the rest of the world.

8. It is true that some, and in certain areas large numbers of, Africans are employed for wages in mines, in railways, in minor industries, in shops and offices of commercial companies, in official service, and in the service of native administrations. But in West Africa the total of Africans so employed is not a large proportion of the population, and the overwhelmingly large number of persons so employed for wages only give a part of their time to such employment and even then maintain their economic connection with a farming community of which they are members in some part of West Africa.

9. To the Briton a country's prosperity is largely measured by the figures of export and import trade. But the figures of export and import trade of West Africa are no true reflection of the conditions and standard of life of West Africans, which is determined by the African's own agricultural economy. In fact, European and American trade to West Africa depends for its existence on the money which the African earns for what West Africa calls "cash crops," or for what he earns when employed for wages. Such cash crops (groundnuts, cocoa and palm oil, for instance) and the money results of such services, largely in connection with the handling of these crops, and to some extent with mining, are exported. West African imports are paid for by money so earned, and consist largely of textile goods and other light consumption goods. It is notable that the firms which buy cash crops and employ African services are, to a large extent, the same firms as sell consumers' goods to the Africans again. This simple form of export and import trade, however, is an addition to the African's own subsistence economy and the essentially barter form of internal trade in West Africa between the African people themselves.

10. The most striking and obvious difference, to the European at any rate, between the subsistence economy of the African and the money economy of the European is the extraordinary low level of money prices of African goods and money payments of wages. Wages to adult males may be as little as 4d a day in certain industries, and a wage of 1/6 a day, even in the capital of Nigeria, Lagos, where standards are relatively high, is a "good" one. A few leading hands (African) in the Nigerian State Railways get 4/2 a day, but there are skilled artisans, such as blacksmiths, boilermakers, carpenters, coppersmiths and electricians, whom they grade down from 4/2 to 3/- a day. Grade A engine drivers get the same wage of 4/2, but firemen vary from 1/9 to 2/4, and cleaners, if literate, get 1/-. The railway service is the aristocracy of the Nigerian labour world, but even here wages are as low as 9d a day.*

11. Prices of African goods are also very low. It is possible in Nigeria to get a cooked meal from a wayside vendor squatting before his fire or broiling pieces of meat on a skewer for as little as a penny. This low level of money prices has called into being a special coin, the anini, the value of which is one-tenth of a penny, and this is the chief coin in ordinary domestic and market transactions in Northern Nigeria and in a large part of Southern Nigeria.

12. These facts are given because it is not possible to compare wages and prices directly with those in Great Britain, for the reason that the West African is all the time relying for his livelihood on subsistence farming. Money sales or purchases are an extra and fall outside his ordinary means of livelihood.

13. This subsistence economy is, to describe it in another way, production for use and not for profit, and must be the basis of the Nigerian financial structure. And this subsistence economy must also be recognised as a basis of a real civilisation, however different from that in Western Europe and America at the present time.

14. It must not be thought that the African is living in a condition of low-grade savagery, in abysmal ignorance, and with no real organised social institutions. On the contrary, African

*These figures were those current at the beginning of 1939

civilisation is a real thing. A large proportion of the people are Mohammedan in religion, and there are schools of Mohammedan learning of great antiquity. The school in Kano is an offshoot of that in Khartoum. The Mohammedan civilisation is centred in Northern Nigeria and is made up of a number of emirates, of which the best known is that of Kano, whose capital city is of mediæval construction, surrounded by a high wall twelve miles in circumference, and dating back to a period before the Battle of Hastings. Nor are the African non-Christians and non-Moslems living under a barbarous mumbo-jumbo. The African non-Christian religion is a real one, and the social systems of the African people are very elaborate.

15. African civilisation, different as it is from our own, is comparable with that of Europe in the Middle Ages, but without the background of Christianity and without the heritage of moral, administrative and intellectual ideas bequeathed to Europe by the civilisations of Greece and Rome. It has, however, an ancient history and links with the civilisations of Egypt and the ancient world, and has been very much influenced by the great mediæval Mohammedan civilisations which flourished in tropical Africa and around the Sahara, and which were closely related to the great Moorish civilisation in Spain.

16. That all belongs to the past, and what is now happening in West Africa is a battle of ideas and economic systems between the African and the European peoples. In your Commissioners' view the only stable foundation for government in West Africa and for economic development is a clear recognition of these differences. We go further and say that in West Africa there should be an explicit understanding that any future economic development must be based on an acceptance of the fundamental importance of farming as the major interest of the African people, and of the communal system of land tenure as the permanent basis of the African's economic life, although this system will need to be broadened out in the future beyond the limits of the family and the tribe.

17. To allow the conflict of ideas and systems between Europe and Africa to go on without guidance is to doom the African system of life to destruction and to produce in its place social, moral and economic difficulties of a far-reaching kind, likely to be very injurious to all relations, including political and commercial. These conclusions, in our view, do not rule out the economic participation of Africa in world trade exchanges and world economic advances. The acceptance of these conclusions is, on the contrary, in our view the necessary basis for such co-operation.

18. Africa is changing and must change as inevitably as Europe and the rest of the world, but the changes must be guided so as to strengthen the security and prosperity of the colonies and to add to African life real advantages for the Africans which arise because of their association with the British Empire.

19. The Governments of the West African Colonies have, in fact, accepted some of these conclusions to a very large extent. The communal system of land tenure is being passively maintained. African rule by Africans according to African law and custom is being maintained, strengthened and extended by the system of indirect rule. But the acceptance of these conclusions needs to be more far-reaching and more far-seeing. It should not only be quite explicit, but its future implications in policy clearly recognised. What is now needed is to carry our acceptance of these conclusions further and to build up an improved economic system, allowing for a greater degree of co-operation between the African and the European and American economic systems. This will bring about an improved standard of life for Africa and give Africans the opportunity of entering more fully into the political life of the world on the basis of equality of status. The attainment of this equality by a programme of ordered development over a period of years should be explicitly stated by the British Government, and it should be explicitly agreed with the leaders of the West African peoples. The main obstacle to this plan of ordered development is not the assumed backwardness of Africa but the lack of confidence and understanding between African and European. We Europeans came to Africa first as slave dealers and later as traders and conquerors. Our administration in West Africa has been an enlightened one, but we cannot escape from our history, and there are barriers of misunderstanding on both sides between us and the African peoples. The problem is political, economic, moral and social.

CONCLUSION

20. It was the original intention of the Commission to report in detail on the political, financial, trade and economic aspects of West African problems. The outbreak of war frustrated this intention by throwing an immediate burden of urgent war work on the members of the West Africa Commission, and by making it inexpedient to discuss many of the questions involved in the necessary detail. The progress of the war has now brought so many changes to West Africa that many of the detailed observations which the Commission made at the time of its visit are out of date. But, whatever the changes, it is on forestry and on agricultural and pastoral farming that the future of West Africa will depend for an indefinitely long period. The reports of the technical experts—now published—give a scientific survey of conditions in West Africa which is of permanent value and, it is hoped, of special value now when colonial questions are being given more careful consideration than at any previous time.

J. SANDEMAN ALLEN

C. G. AMMON

E. CLEMENT DAVIES

L. HADEN GUEST

PART I

REPORT ON CROP PRODUCTION AND SOIL FERTILITY PROBLEMS

BY

H. C. SAMPSON, B.Sc., C.I.E.

AND

E. M. CROWTHER, D.Sc., F.I.C.

INTRODUCTION

21. Two considerations have led us to restrict the scope of our Report on the agriculture of West Africa to the two groups of problems set out in the title. Our past experience has been mainly with crop production and soil fertility problems in Great Britain and various parts of the tropics, and in a hurried tour of a little over three months we naturally gave most attention to those questions in which we were best qualified to appreciate both the broad aspects and the details of the current work. Our visit was made in the last cold season before the war. The general economic, administrative and political issues will be so profoundly modified by the war that any discussion here would be superficial and out of date. The technical problems of agriculture will, however, remain substantially unchanged, and we have set out our views on them in some detail in the hope of providing material and suggestions for those who will work out the new colonial policy.

22. We have not burdened our Report with data for the production and export of various crops or with other statistics which are readily available in the Handbooks and Annual Departmental Reports of the various colonies.

23. We begin by describing the fundamental natural factors of the environment into which agriculture has to be fitted—the geology, the soils, and the climate—and we mention some of the ways in which man has interfered with them to his own disadvantage. Then we discuss the principal food crops, emphasising the point that many of them have been introduced under European influence during the last few centuries. Next follow descriptions of some of the main types of agriculture from the traditional methods of subsistence farming among the pagan tribes to the various attempts to establish plantations or a stable form of mixed farming.

24. As a preliminary to considering the work of the Agricultural and other Government Departments we describe the historical development of the British approach to tropical agriculture and forestry, and show how the pattern of the last few decades has been influenced by the Indian model. We point out some of the fundamental contrasts between West African and Indian conditions. We emphasise the need for organising scientific research and survey on a much larger scale, with the objective of working out an ecological interpretation of the country and its mode of life. Only in this way will it be possible to develop stable methods of more intensive agriculture.

CHAPTER I

GEOLOGY AND SOILS

25. The continued prosperity of an agricultural community depends ultimately on the productivity of the land. This may be improved by suitable methods of management, but in the long run limits are set by the environment. The fundamental factors are the climate and the long series of processes by which soils have been built up from the underlying rocks. Western European experience in intensifying the output from arable land has been obtained

under a narrow range of conditions in the temperate climatic zone on soils formed under broad-leaved forests and grass. The farmer's constant struggle has been to prevent weeds, grass, and scrub from re-colonising his fields. To this end he has evolved crop rotations which include frequently cultivated fallows or root crops and the alternation of tillage crops with leys for hay or grazing.

26. The indigenous agriculture of the tropics proceeded on other lines. We shall refer later in this Report to the efficiency of many stable forms of subsistence farming in West Africa, and also to the troubles which have arisen when African people have moved over into a new region. Not only may the traditional methods be unsuitable for the new conditions, but the African may lose his ancestral regard and feeling for the land. In some parts, e.g., around Onitsha, we saw gross forms of land exploitation by recent African immigrants. The same thing happens when, through litigation, land passes into the hands of absentee landlords in the towns.

27. New and more productive methods of agriculture are essential, but before their introduction is encouraged on a large scale by economic stimuli or by agricultural education one has to make sure that the new methods will be of permanent value.

The Formation of Soils

28. Soils are produced by the action of moisture, vegetation, animals and man on the loose products formed by the weathering of rocks. Since climatic factors are involved at every stage of these processes, it is clear that there must be a broad parallelism between soil types and the main climatic belts. A fundamental difference must therefore exist between the soils of West Africa and those of the temperate countries in which European officers, traders and planters obtain their early experience and training. A newcomer is struck by the luxuriance of the tropical vegetation along most of the West Coast, and is inclined to ascribe this to the intrinsic richness of the soils instead of to the high humidity, which is in fact the principal factor. Although newly cleared land may promise well for the first season or two, planters have learned by bitter experience that supreme care has to be taken from the commencement if the slender reserves of fertility in most soils of the wet tropics are to be conserved.

29. In the drier parts of Africa the general practice is to alternate a few years of exploitation for cultivated crops with a longer period of resting under bush. One of the most general problems in such areas is to devise methods by which this system of agriculture can be intensified without risking serious degradation of the soils.

30. In modern soil science emphasis is laid on the processes of soil formation or degradation. Under natural vegetation, or under a long-continued system of agriculture, these processes may settle down to an approximate equilibrium, but any drastic change in soil management may allow full play to the destructive forces whilst checking the restorative ones.

31. In any district of West Africa the individual kinds of soil appear to occur in a bewildering mosaic, but there is generally a close relationship between the soils and the relief, with a repeating but complex pattern from the crests of hills, down the slopes, to the valley bottoms. Detailed mapping of soils is clearly out of the question in such vast areas, but it is possible for experienced workers to recognise the main sequences and patterns, to examine typical members, and to attempt an interpretation of the formation and properties of the main kinds of soils. Throughout his work the soil surveyor must take account of geology, natural vegetation and native agriculture; and must analyse and interpret all the numerous sets of conditions. Some of these are of course already well known to the African and to the European agricultural and technical officers, but systematic surveys by teams, including soil scientists, geologists, ecologists and agricultural officers, will provide the best basis for co-ordinating and using local information, whatever its origin. Only a few of the broadest factors involved can be considered here.

Geology of West Africa

32. The bulk of West Africa forms a vast plain (peneplain) worn down through geological time to expose crystalline rocks of the highest antiquity (pre-Cambrian age). These materials are hard contorted and foliated rocks, consisting mainly of gneisses, schists and quartzites. They are somewhat similar to those of the highlands of Scotland and the north-west coast of

Ireland. In a few areas intrusions of granite and other igneous rocks have great economic importance on account of the minerals—tin, diamonds, manganese, etc.—associated with them. Occasionally, as around Victoria in the British Cameroons, outpourings of basic igneous rocks have produced soils of great intrinsic fertility. Along the coast, except in the vast delta of the Niger River, the surface of the land is much more irregular than further inland. The high rainfall has caused valleys to be carved out from the softer rocks—shales, sandstones, etc.—occurring between the more resistant quartzites and greenstones. Beyond the coastal hills the bulk of the country has been worn down to a flat or gently undulating surface which bears little relationship to the old rocks below. These may, however, be exposed as isolated hills—*Inselberge*—where a protective coating has been removed relatively recently.

33. The land mass of West Africa has had no such chequered history as the British Isles, where repeated changes of the relative levels of land and sea have built up the bands of clays, sands and limestone which have been exposed by denudation or redistributed by glaciation to form the bulk of our agricultural land. Throughout the geological periods in which new deposits were being laid down in what is now the British Isles, the wasting processes have gone on almost unchecked in West Africa, constantly carrying the finer and soluble products out to the sea. A few sedimentary beds in the Gold Coast—the Voltaian shales—are important as water bearers. In Nigeria Cretaceous shales, sandstones and limestones occur in the Benue and Gongala Valleys ; much more recent sediments (Lower Eocene) are found between Calabar and Lagos, in the Niger Valley to Jebba, in Sokoto, and in the Niger and the Bauchi Provinces. The youngest geological deposits are the Benin sands, which cover the bulk of the oil-palm belt, and the important Chad group in which sub-artesian water can be exploited by open shafts.

34. The plains of Northern Nigeria and the Gold Coast are generally covered by loose deposits of drift, which smooth out the irregularities in the solid rocks beneath. This drift is mainly alluvium, a fine material deposited from running water, with some admixture of wind-blown sand.

" LATERITE "

35. The drifts of Northern Nigeria, the Northern Territories of the Gold Coast and parts of the adjacent French territories frequently have a pronounced ironstone crust, commonly known as " laterite," at or just below the surface of the soil. This laterite may extend as a sheet for many square miles, attaining in places a thickness of several yards ; or, alternatively, it may occur as detached boulders far removed from a continuous layer. The relation between the sheets and the isolated boulders can be seen in the flat-topped hills in many parts of the Jos Plateau, but particularly well in the two hills within Kano city. The level tops of these hills consist of cellular ironstone, often with a hard lustrous surface. The steep sides are littered with boulders of ironstone, which have fallen down as denudation has eaten away the hill. Similar isolated boulders are strewn over the surrounding plain. These hills illustrate very well the general progress of denudation from one plain to a lower one. The ironstone caps on the Kano Hills contain boulders from an earlier and higher plateau, and the accumulated ironstone debris at the foot of the hills is again being cemented into a loose ironstone cap. The fine material and some of the soluble products washed away by the rains accumulate in the lower ground. Erosion from the slopes to the low ground proceeds at varying rates throughout the whole of the gently undulating country. Once this process is recognised it gives the key to the pattern of the landscape and the utilisation of the land. Each stage has its own characteristic vegetation and types of soil formation and degradation. The sequence of soils is conveniently described by the technical term " catena." It may be recognised many times a day on any motor journey through the northern regions. The road cuttings or borrow-pits near the crests of slight ridges show red soils, often with an ironstone crust, and sometimes with boulders of ironstone. Further down the slope the soil is less red, but still of a warm hue. The soils of the lowest ground are grey and generally of finer texture, and the borrow-pits show by a variety of stains that these soils are flooded or waterlogged for considerable parts of the year.

36. The term " laterite," already mentioned, is used in such a variety of senses that some explanation seems necessary. The term is used loosely to cover not only the hard ironstone cap or bands of ironstone gravel but also any reddish earth which is sufficiently friable and

[PARA. 53

Gully erosion approaching main road near Zaria, Northern Nigeria

[PARA. 55

Gully erosion near Udi, Eastern Province, Nigeria. The gully in the centre is being checked by weirs

permeable to give a serviceable surface for roads and paths. The Nigerian engineers restrict the term " laterite " to the red granular road material, and use " hard laterite " for the material dug out by chisels and used directly as building stone. The term has in fact been used so widely that it now seems too late to attempt to give it a precise scientific meaning. An essential chemical feature is the large proportion of alumina or iron oxide, left by the leaching away of silica and bases. In the narrow chemical sense of the term it would appear that the only true laterite in West Africa occurs on the tops of some of the high hills of the southern part of the Gold Coast and in Sierra Leone.

37. Sometimes laterite has been " refined " further to leave workable deposits of bauxite, a commercially useful ore of aluminium oxide. Lower down the hills in the agricultural districts of the south of the Gold Coast and Nigeria the soils do not form continuous sheets of laterite. Below the loose surface soils there is generally a band with quartzite gravel and hard nodules of ironstone resting on loose material, with softer lumps of ironstone or merely iron stains in little pockets. These nodules tend to stick together, and the remaining fine material may be washed away to leave a characteristically vesicular product. Often these bands and ironstone nodules bear some relation to the level of the water table.

38. Although some of the ironstone caps in the north may still be growing slowly, it seems almost certain that the bulk was formed in some earlier and much wetter geological period.

39. Apart from their obvious convenience to the engineer, soils of the lateritic type are interesting because they represent an extreme stage of weathering and exhaustion.

Soils of West Africa

40. The most common soils of West Africa, which are classified simply as " Red Earths," show some of the characters of laterite. Heavy leaching at high temperatures has removed the bulk of the bases and much of the silica. The fine material present resembles china clay, in being devoid of plant food and in lacking stickiness and cohesion. The iron and aluminium oxides bind phosphate into very inert forms not available to plants.

41. A second common type of soil, a " Grey Earth," occurs in badly drained depressions. It is known as " firki " in Northern Nigeria.

42. In very dry areas (which we did not visit) there is a third broad type—a " Black Earth," resembling the " regur " or " black cotton soil " of India. This is a heavy dark-coloured soil, impossible to work when wet, and cracking deeply as it dries. It generally contains concretions of calcium carbonate, and may be alkaline as the result of the accumulation of sodium in association with the clay. This soil occurs in depressions in the dry regions around Lake Chad.

43. There are, of course, innumerable varieties of these main types, representing different stages in formation or degradation, and reflecting to varying degrees the effects of the parent rock from which they were derived.

44. Serious study of West African soils has only recently commenced. In Nigeria the agricultural chemists have produced a preliminary soil map with a broad grouping based mainly on geological characters. They have also studied in detail one or two soil types, notably the " ilepa " type around Ibadan. Within the last few years the Agricultural Chemist of the Gold Coast has devoted much of his time to a systematic study of the soils of the Experimental Stations in the Southern Gold Coast. Some years ago a preliminary soil survey was made for Sierra Leone, and the composition of some of the laterite soils studied in detail. So far, in all three colonies, the bulk of the work on soils has been done in the laboratory, often on samples sent in by agricultural and other officers. This work was necessary, but the staff should be augmented sufficiently to allow much more work in the field.

Soil Fertility

45. Some of the more general aspects of the soil fertility questions in West Africa will be discussed later in this Report. Here it will be sufficient to stress the intrinsic poverty of most of the soils and the vital part played by the vegetation, both in maintaining the fertility and in protecting the surface soil from destruction by erosion through water and wind.

46. Any cover of vegetation tends to keep down the soil temperature and to return some organic matter to the soil. The leaves reduce the beating force of rain, and the roots tend to hold the soil and to build up more stable granules.

47. At high temperatures the organic matter added to the soil in roots and leaves decomposes rapidly. In consequence, most soils of the dry tropics contain far less organic matter than those of temperate climates.

48. The ground vegetation is particularly important for maintaining an irregular and porous soil surface to absorb water and prevent sheet erosion. Modern work on soil conservation has demonstrated the supreme importance of the ground cover, which is often dependent on the trees of the forest for its maintenance and protection. These beneficial effects are recognised by governments when they protect watersheds by making forest reserves. But these effects often operate on agricultural land, and the necessity for maintaining efficient soil covers is now recognised in the few European plantations of the West Coast. The Department of Agriculture are endeavouring to apply similar methods to cocoa* farms in which a break in the canopy may provide a focus from which desiccation and loss of soil fertility will spread.

49. Besides these more purely physical benefits from a good cover of vegetation there are biological and chemical ones. Many of the plants fix atmospheric nitrogen, and additional quantities may be fixed by free-living micro-organisms in the soil. Most soils of the wet tropics are very deficient in bases, notably calcium and potassium, and in phosphate. The soils have been heavily leached ; they are short of humus, and their mineral colloids not only contain very little base but have little power of retaining added bases. The general shortage of lime in West African soils and crops is reflected in many ways. Almost all household waters are soft. The native cattle are small ; indeed the steady increase in size of the native cattle from the coast through the drier belts to the fringes of the desert in the north reflects the increasing calcium content of the soil and herbage as the rainfall and consequent leaching fall off. West African elephants are generally small, though larger specimens have been found in a few isolated spots, e.g., on the basic volcanic soils of the Cameroon Mountains. Medical men know that much of their work arises from calcium deficiency among a people who do not drink milk and whose vegetable food is low in calcium. It is possible that many native food practices, e.g., the use of a variety of leafy plants as " spinach," and of baobab and other leaves in soups, go some way to meet the body's need for calcium as well as for vitamins.

50. There are good grounds for believing that many of the traditional agricultural practices are to be explained in terms of calcium, potassium and phosphorus. The circulation of nutrient elements from soil to plant and back again is for the most part limited to a few inches of surface soil. The small reserves are temporarily locked up in the decaying organic matter of the top soil ; the subsoil is normally very poor in nutrients. When the surface reserves are used up or lost through cultivation, the normal native practice is to clear a new site and abandon the old one to bush. Deeply rooting coppiced trees and shrubs can then bring up some further supplies of plant nutrients from depths where weathering is still in progress, and add them to the modest stocks held in the vegetation and top soil. Under high bush this leads to a soil condition which seemed very puzzling when it was first discovered in Nigeria by H. C. Doyne. The surface soil is far less acid (or lime-deficient) than the subsoil, whereas in temperate climates the surface soil is generally the more acid. The fact that the surface soil in tropical forests is normally much richer than the subsoil seriously aggravates the losses incurred by soil erosion.

51. Finally, the mineral elements are extremely important in attempts to combine mixed farming with the production of export crops. The farmyard manure returns to the land some of the plant nutrients in crops and litter, but it must be remembered that the products with most phosphorus—the grains and seeds of cotton and groundnut—are either consumed as human food or exported. The balance cannot be maintained unless additional phosphate is brought in from elsewhere, either as litter and fodder from bush or pastures outside the farm, or as fertilizers. One should not make the mistake of mentally equating the farmyard manure of the West African " mixed farm " with that of a British farm, which receives very much heavier dressings of material containing the residues of purchased feeding stuffs. Much of the phosphorus from the Nigerian farms finds its way back to the soil on British farms, and not on Nigerian

* The word " cocoa " is used throughout this Report to denote both the product of the cacao tree and the crop itself.

ones. The British farmer rightly attaches great value to the manurial residue of his purchased feeding stuffs, and is credited with their estimated value when he gives up his tenancy. In the nineteen-thirties British farmers bought in imported feeding stuffs far more nitrogen than in fertilizers, and as much phosphate and potash as in the whole of their superphosphate and potassic fertilizers. The West African farmer exports his richer products and makes no corresponding return to the land, even if he follows to the full the present recommendations of the Department of Agriculture.

SOIL EROSION

52. In the last decade or two the world has become erosion-conscious. The experience of early plantation agriculture in Ceylon, Malaya and elsewhere showed the dangers of clean-weeding and the need for terracing, silt-pitting, draining and cover-cropping to reduce surface-wash and gullying. In the United States a vast Soil Conservation Service was charged with the duty of investigating scientifically the adaptation of agricultural practice to the environmental conditions.* For a survey of the problem as it affects a variety of countries, reference should be made to two recent books by G. V. Jacks and R. O. Whyte,† and to two reviews by Sir Frank Stockdale.‡ The administrative difficulties of introducing new soil conservation measures are obviously acute in countries of peasant farmers and nomadic cattle keepers.

53. It is noteworthy that the pagan tribes often terrace their land in hilly districts. We saw low, widely spaced terraces on the edge of the Bauchi Plateau and in North Mamprusi, more striking ones on steeper slopes at Ikegwe, and photographs of stone-walled terraces in parts of Adamewa Province, which resemble those of European vineyards or the well-known terraces of Java and Madeira. Such treatment was essential for stable agriculture. In the more recently developed areas we saw dangerous gully erosion on the edge of the Cretaceous escarpment near the Udi coalfields, on the Benin sands between Onitsha and Owerri, and in the north along some of the new all-weather roads. There is a dreadful gully system between Samaru and Zaria, which will shortly be threatening the main road and a Public Works Department Labourers' Camp, and another one near the first river bridge on the road from Zaria to Kaduna. Another bad example on the new road from Dawdawa to the railway station at Chemi appeared to have started from an Irish bridge. During our tour it was inevitable that we should see many gullies along the roads, but it would be wrong to imply that the Nigerian Public Works Department is to blame. Indeed, we wish to pay our tribute to the obvious care with which they have led away the run-off waters by carefully spaced and graded drains. In this direction Nigeria is clearly ahead of the Gold Coast, where too often the roads have such ugly open and eroding drains on either side that there is no ready escape from a charging cocoa lorry.

54. The sanitary departments and the authorities responsible for the upkeep of public buildings are sometimes bad offenders. Around hospitals and houses constant sweeping creates depressions which develop into pools and then to gullies. Many buildings now stand well above their original ground levels and with their foundations exposed. For soil protection, as well as for the control of mosquitoes, it would be a sound rule to keep paths in grass or in maintained gravel.

55. Only in two places did we see experimental attempts to control gully erosion. Near Udi in the East Province of Nigeria two systems of gaping gullies in grass-covered sandhills of Cretaceous origin were being checked by weirs, with wave beds planted with seedlings of the tree *Acioa barteri* to protect the grassland behind. The experimental measures cost about 25/- per acre. Some such methods of soil conservation are needed to protect the surrounding country, but it must be realised that this land can never be made safe for farming in the traditional African method, which is still carried on most dangerously on some of the steep slopes of the escarpments above Enugu.

56. The other trial was in loose red Benin sand, again in grass, to the east of Onitsha. Here deep gullies, which would shortly have threatened the main road, had their heads in a former town or market site. At about six inches below the uneroded surface there was an almost continuous horizon of potsherds, which, when exposed by erosion, formed characteristic

* See, for example, the authoritative work of H. H. Bennett, "Soil Conservation," 1939.
† "Soil Erosion and Soil Conservation," Imperial Bureau of Soil Science, Technical Communication No. 36, 1938. "The Rape of the Earth," Faber & Faber, 1939.
‡ "Soil Erosion," *Empire Cotton Growing Review*, 1934, 12, 1-8. "Soil Erosion in the Colonial Empire." *Empire Journal of Experimental Agriculture*, 1935, 3, 281-297.

pinnacles of loose sand protected on top from rain. We were informed that this pottery had quite different markings from that now made. It would be instructive to examine the area archæologically and to study local memories and tradition. The reactions to the very modest preliminary attempts at controlling erosion raise a question which merits serious consideration. We were told that in a nearby gully the villagers had pulled out the *Acioa* seedlings planted in the wave beds; they said that they would rather see the whole countryside washed away than get into the hands of the Forestry Department as a reserve. Here again it is doubtful whether the land can be conserved for farming, except in little pockets at lengthy intervals.

57. Some experiments must undoubtedly be made to discover means of checking the further growth of gullies, if only to save the roads, but the whole problem needs careful examination before a general policy can be applied widely. The land actually threatened may be of low agricultural value, whether protected or not, but the importance of the gullying cannot be assessed until surveys have shown how far fertile land lower down the valley is being damaged and waterways and bridges threatened. Any systematic attack must presumably work through the Native Administration, and must not unduly arouse the opposition of the local population. We would suggest that the whole problem should be studied by a political officer. He must, of course, have technical assistance, but it seems unwise to create the impression that a forest reserve may be made in the middle of a densely populated area.

58. Our description of a few striking examples of gully erosion must not be taken to imply that this problem is serious throughout West Africa. Indeed, we saw little evidence of it where traditional agricultural practices are maintained. Difficulties arise from new developments, such as the growth of towns, the spread of roads and the introduction of new methods of cultivation, especially for cash crops and with the aid of the plough. We discuss elsewhere the need for caution in clearing the bush and removing the stumps for mixed farming, until it is known whether the land will in fact stand continued cropping. There is room for investigations in regenerating bush by coppicing some of the useful trees. Reference should also be made to the possibility that the very success of the veterinary departments in combating cattle mortality, especially from rinderpest, may lead to a danger of overstocking, which has had such disastrous results in parts of Kenya and Tanganyika. If these problems are studied in time it may be possible to avoid some of the misfortunes which have occurred in other parts of Africa, where uncontrolled developments have taken place more rapidly.

59. Soil conservation should begin at the watersheds, and the Forestry Departments are making suitable reserves in the natural forest of sparsely occupied areas. We would, however, draw attention to an inconspicuous but no less vital watershed, whose significance may not be realised outside the departments technically concerned with these questions. The new all-weather road from Kano to Zaria, on the stretch where it turns south from the Katsina road, runs through apparently flat country. This is, none the less, a watershed, for all-weather roads must follow watersheds. Farms are rapidly being opened from fairly old bush along this road, and there is a risk that sheet erosion and, later, more dramatic gully erosion may set in, unless the farming systems afford reasonable protection.

60. We were informed that in this region there are already indications that the rivers are silting up dangerously. Even without unusually heavy rainfall, flood waters have approached bridge levels regarded as safe when they were constructed a few years ago.

61. In those parts of Sierra Leone which we were able to visit, large areas of heavily eroded country can probably not be restored to stable farming. In and around Freetown there are many almost barren flat stretches where the ironstone is practically at the surface. The hillsides have lost their trees, and much of the soil in the undulating country is so thin that both the crops and the bush are poor. The Department of Agriculture recognises the difficulty, and is therefore endeavouring to develop swamp rice cultivation as a substitute for hill rice. They are in fact trying to persuade the farmers to follow the soil down to the rivers and swamps, in the hope of leaving the uplands sufficient time to grow more soil.

62. In the United States it has been necessary in some of the most dangerous areas to transform the whole system of agriculture to make it fit more safely into the environment. Sometimes, as in the famous experiment of the Tennessee Valley Authority, works begun to keep

[PARA. 82

Yams stored on racks at Ahiara, Eastern Province, Nigeria

[PARA. 89

A family compound in the Pagan country near Zonkwa, Northern Nigeria. The roof of the dwelling-house in the centre is asymmetrical, with the apex towards the rear. This draws smoke away from the front room and provides a loft for storing firewood and other goods. The clay granary is supported on stone pillars to keep out white ants. The building behind the granary is used as a goat shed, and its doorway is barred by wooden logs behind upright stones

the rivers navigable have profoundly modified the whole land-use of the surrounding country and effected a social revolution. It may well be that drastic changes will have to be introduced in parts of West Africa ; and it will be necessary at an early stage to consider whether steps should be taken to strengthen the powers of the central governments before those of local administrations become too deeply entrenched. Already, in building trunk roads and sinking wells, the emirates of Northern Nigeria work at different rates, determined by their resources and not by the needs of the situation. If restrictions must be applied to safeguard farms, bridges and roads lower down the valley, the control of the financial resources should remain in the hands of the central government.

CHAPTER II

THE AGRICULTURAL CLIMATE OF WEST AFRICA

63. The system of farming adopted and the type of crops grown depend on the distribution of the rainfall rather than on its annual total.

The Coastal Regions

64. Where there is no definite dry season, farming is based mainly on root crops, which require a long growing season. They are supplemented by semi-permanent crops, e.g., banana and plantain, or permanent ones, e.g., oil palm and cola nut, as well as crops of recent introduction, such as cocoa and, in some parts, coffee. These areas are concentrated on or near the coast, but they do not form a continuous climatic belt. They extend from the Bight of Biafra, bordering the Cameroons, along the south of Nigeria as far as the boundary of Dahomey. Here the climate is much drier, as evidenced by the deciduous type of vegetation and the presence of such trees as the baobab, the borassus palm and the shea butter tree, all of which are found adjoining the coast. In Togoland the rainfall is more widely distributed, but the vegetation is still mostly of the deciduous type, indicating a dry season. The south of the Gold Coast, except the low lying Accra plain, and the south of the Ivory Coast are again regions of high evergreen forest, with a rainfall distributed throughout the year ; one imagines that this extends through Liberia to Sierra Leone. Though Sierra Leone has the highest rainfall of the whole of West Africa, apart from the immediate neighbourhood of the Cameroon Mountains, and though it maintains, in the south at any rate, an evergreen type of forest, the distribution of the rainfall is entirely different. There is an intensely wet season from the end of May to about October, followed by a very dry season. In the Gambia there is also a rainy season followed by a long dry season, but here the rainfall is relatively low, amounting to only some 45 inches during the June to September season. In all countries with a dry season the indigenous agriculture is based on cereal crops, supplemented, where necessary, by cassava and sweet potatoes.

The Middle Belt

65. To the north of the above regions the climate is divided into two periods. There is a rainy season which commences in about May to June and extends to about September to October. This, of course, varies in intensity and duration with the topography of the country and with the distance from the sea. The greater part of the rain, brought in by the south-west trade winds and diverted in a north-easterly direction where these meet the coast, falls on those regions nearer to the sea. The amount of rain and the duration of the rainy season decrease in a northerly or easterly direction.

The Northern Region

66. North of this middle belt the rainy season is shorter and usually not so intense. Here agriculture is based almost entirely on annual crops which can mature with the moisture supplied by the rainy season. Cassava, it is true, has recently found its way into these northern areas, where it is often treated as a biennial crop ; but it can be looked upon mainly as an insurance against famine in the event of locust invasion. Cassava is one of the few crops not eaten by locusts.

" The Advance of the Sahara "

67. The dramatic onset of wind erosion in the " Dust Bowl " of the United States in the early nineteen-thirties created uneasiness in many other countries. There was something

approaching alarm in certain quarters when, after a recent visit to West Africa and a journey across the Sahara, Professor Stebbing of Edinburgh suggested that there was more than a possibility within the next fifty years or less that Kano itself might be overwhelmed by the Sahara, should the present methods of agriculture, grazing and firing of the forest continue on an increasing scale.

68. Fortunately one part of the problem has recently been examined by a competent Anglo-French Forestry Commission, which failed to find any definite evidence of increasing aridity or any general danger of desiccation.

69. All the evidence collected by the Geological Survey of Nigeria and the Anglo-French Forestry Commission shows that the water table is, to all intents and purposes, stationary. The native shafts fail to yield water, not because the water table is falling, but because the primitive methods of construction, employed when there was abundant slave labour, did not allow the wells to be carried far into the water table. Nowadays there is little inclination to use the laborious old methods to replace wells which cave in or get blocked by debris. It is often simpler to migrate than to sink a new shaft.

70. The Anglo-French Forestry Commission reported that the sylvan condition of the country is unquestionably being impoverished by the uncontrolled expansion of shifting cultivation as a result of the security afforded by European administration. A large part of the natural woodland has been so seriously degraded in quality that it is of very little use ; except in a very few localities it has not been replaced by farmland of real value.

71. The Commission also makes recommendations for dealing with the damage to germinating crops by sandstorms from the east at the beginning of the rains. The remedies are shelter belts at right angles to the winds, a fairly large number of trees in the farmlands, and hedges and lines of trees to mark field boundaries.

72. We may add from our own observations that it is perhaps unfortunate that the Departments of Agriculture should find it necessary to cut down trees over most of their Experimental Stations and Demonstration Centres, and that in the work of the Forestry Department which was shown to us we failed to find anything on the vital questions of making hedges or of coppicing trees on cleared land to allow a more rapid regeneration of the bush.

73. It is sometimes suggested, e.g., in Lord Hailey's *African Survey*, p. 1104, that " the fine sand blown in from the north by the seasonal 'harmattan' is a factor, although not the major one, in deteriorating conditions." We must, however, point out that, although only small amounts of material are deposited each year, they are likely to do more good than harm to the soil. The " harmattan " dust is not sand, but an alkaline clay far richer in plant foods than the soils on which it falls.

CHAPTER III

THE CROP PLANTS OF WEST AFRICA

74. The agricultural practices of West Africa have originated in the types of crops grown. Besides those indigenous to West Africa we have to consider crops introduced from the east at an early period and those introduced since European influence first reached the Coast. These last can again be divided into early introductions for the use of the West African peoples, and recent ones to supply European markets with tropical products in exchange for money or trade goods.

Northern Indigenous Crops

75. The agriculture of the dry zone of the north is based on annual crops which can reach maturity with the aid of seasonal rains.

76. Botanical evidence shows that existing agricultural practice must date back to very early times, for the principal cereals are definitely of local origin and are represented by numerous varieties. These cereals consist of grain pennisetums, commonly known as " millets," and grain sorghums, commonly known as " guinea corn." In the southern part of the Northern Belt, where the rainfall is heavier, another indigenous type of cereal is grown. This is found among the pagan tribes of Nigeria in two species of *Digitaria*, viz., *D. exilis* (Kipp.) Stapf, and

D. iburua Stapf; the former extends westwards as far as the Gambia. These are known as "Acha" or "hungry millet," the latter name being probably due to the fact that the crop ripens early and supplies food during the time of annual scarcity. In addition to cereals the cowpea (*Vigna unguiculata* (L.) Walp.) is universally grown as a pulse crop, being mixed with the cereal crop. The cowpea is represented by numerous varieties, and it seems probable, therefore, that the crop originated in this part of Africa. Oilseeds are poorly represented, though beniseed (*Sesamum orientale* L.) is fairly commonly grown among the pagan tribes of Northern Nigeria. Botanical evidence indicates that this species is of African origin.

77. Of industrial crops there are several. Cotton of an Old World species is indigenous and is still occasionally seen in cultivation. *Hibiscus lunariifolius* Willd. ("Rama") is grown in the immediate vicinity of the homestead, its leaves being used as spinach and the stems retted for rope fibre. *Hibiscus sabdariffa* L. or roselle is widely grown, its fleshy calices being used, either fresh or dried, in soups, as well as the ripe seeds when the crop is harvested. *Indigofera arrecta* Hochst., an indigenous African species of indigo, is widely grown in Northern Nigeria to furnish a blue dye, and there is evidence in the accumulation around the dyeing vats that this is a very old industry. Near every village, including abandoned village sites, the baobab (*Adansonia digitata* L.) has been planted, and the young leaves are collected, shade-dried, and used in soups. One sees these dried leaves exposed for sale in every market of the north, and it is claimed that they do much to meet the calcium deficiency in the diet. The fact that the leaves are dried in the shade suggests that some light-sensitive vitamin is retained. Gourds (*Lagenaria vulgaris* Ser.) of various shapes and sizes are commonly grown, sometimes on an extensive scale, and one occasionally finds the water-melon (*Citrullus vulgaris* Schrad.) as well as other cucurbits in cultivation.

Northern Introduced Crops

78. There appear to be very few introduced crops in this northern region. The groundnut (*Arachis hypogæa* L.) must have been introduced from the New World at an early period of the slave trade, for it is known that this South American crop was first introduced into Jamaica via West Africa during that time. Its cultivation has now expanded throughout the lighter soils of the northern type of agriculture, where it not only supplies an oilseed for local consumption, but at the present day forms a valuable export crop. The indigenous cotton has been largely replaced by New World cottons. *Gossypium punctatum* Schum, et Thonn, was an early European introduction and extends throughout the dry north of West Africa, though its cultivation in Nigeria has in recent years been discouraged by the introduction of other kinds. In many parts of French West Africa a recent cross between two Indian cottons ("Karunganni" and "Garo Hills" cotton), known as "Bidu" cotton, is now largely grown as a rain-fed crop, while, in Northern Nigeria, Allen's Long Staple cotton (*G. hirsutum* L.) has replaced *G. punctatum*. Root crops are represented by the "Hausa potato" (*Coleus dysentericus* Baker), which in some places is grown in the moist soils of drainage catchment areas.

Southern Indigenous Crops

79. In the heavy rainfall area of the south, where there is no really dry season, strictly indigenous crops of any importance appear to be lacking, unless one includes the oil palm (*Elaeis guineensis* Jacq.) and the raffia palm (*Raphia hookeri* Mann & Wendl.). The former is always associated with man, i.e. it is not considered to be really wild. The raffia palm is cultivated both for the sake of its fermented sap or "palm wine" and for the leaf fibre obtained from the leaflets of the young leaves, known to gardeners in Great Britain as "bast." Of indigenous West African crops, the yam was probably introduced into this region in Nigeria when the tribes now occupying this country were pushed southwards by waves of conquest from the north.

Southern Introduced Crops

80. The coco-yam (*Colocasia antiquorum* Schott.), the plantain (*Musa paradisiaca* L.) and the banana (*Musa sapientum* L.), which are grown in the high rainfall area of the south, must have been introduced from Asia at an early period. It was from West Africa that these were originally introduced to the New World.

81. The discovery of the New World and the urge to develop the resources of that vast continent for the benefit of the white races of the Old World was responsible for the development

of the slave trade from the African continent. The slave traders must have been hard put to it, not only to feed the slaves collected at the forts which had been established on the coast, but to provision their ships for their voyage across the Atlantic. This, one presumes, was responsible for the introduction of several important food crops to West Africa, as well as other crops conducive to the welfare of the African people near the coast. It was during this period that the cassava (*Manihot utilissima* Pohl.), *Xanthosoma sagittifolia* (L.) Schott.—the American aroid which is the equivalent of the coco-yam of the Old World—the sweet potato (*Ipomea batatas* L.), the groundnut (*Arachis hypogæa* L.), maize (*Zea mays* L.), the Lima bean (*Phaseolus lunatus* L.), and red peppers (*Capsicum annuum* L. and *C. frutescens* L.), the pineapple (*Ananas comosus* (L.) Merr.), the papaya (*Carica papaya* L.) and cotton (*Gossypium vitifolium* L. and others of the *G. barbadense* group) were introduced. The importance and value of these introductions can at once be realised, for in one part or another of the coastal belt all these crops appear to have soon become established with the exception of the groundnut, which had to extend to the drier north before suitable conditions were found. The cassava is perhaps the most important of these introductions, for, with the advent of a more peaceable regime after the abolition of the slave trade, this crop has done much to preserve the country from a too rapid exhaustion of its fertility. The African soon discovered that cassava was not exacting in its cultural requirements, and that it could be planted as the last crop in the rotation and left to fend for itself when land was allowed to revert to bush fallow. In many areas this did away with the necessity of clearing fresh land each year for the yam crop, a system of cropping which at the present time is having such disastrous results in the region occupied by the Munchi tribes.

Middle Belt Indigenous Crops

82. In this region of Nigeria and the Gold Coast the most important indigenous crop is the yam. This cultivation must date back to very early times. Three species are grown, and two of these are represented by many varieties. These are the common or white yam (*Dioscorea rotundata* Poir.) and the yellow yam (*D. cayennensis* Lam.). Both of these are cultigens derived from wild West African species of *Dioscorea*. A third West African species, known as the Esuri yam (*D. hispida* Dennst. var. *dumetorum* R. Kunth), is also occasionally cultivated. The cultivation of the yam crop reaches its greatest perfection in the country south of latitude 10°N. and north of the region of evergreen forest both in Nigeria and in the Gold Coast. Numerous subsidiary crops are grown on the sides of the yam heaps. Those which are indigenous to West Africa are the Bambara groundnut (*Voandzeia subterranea* Thou.) and a somewhat similar species known as *Kerstingiella geocarpa* Harms., a yam bean known as *Sphenostylis stenocarpa* Harms., *Polygala butyracea* Heck., which yields the bast fibre of the Munchi country, and the okra (*Hibiscus esculentus* L.), whose fruits are used as a vegetable. In the Munchi country beniseed may be broadcast after the yam heaps have been levelled down. In some areas *Ceratotheca sesamoides* Endl., a plant somewhat resembling beniseed in appearance, may be sown, but this is not commonly grown on any large scale. *Hibiscus sabdariffa* extends as far south as the Middle Belt, in parts of which it may be extensively grown.

Middle Belt Introduced Crops

83. The most important introduced subsistence crop is the Greater Asiatic yam (*Dioscorea alata* L.). Various types of the vitifolium group of the New World cotton, *Gossypium barbadense*, as well as the Lima bean and maize are grown. Cassava may be planted on the old yam heaps prior to the clearing being abandoned.

Crops of Sierra Leone and the Gambia

84. The peoples of Sierra Leone were at one time definitely cereal-eating ; now the cereals are supplemented by root crops introduced from the New World. Hill rice is the most important indigenous crop in this country. This species of rice (*Oryza glaberrima* A. Chev.) is considered to have originated from the wild tropical African species, *O. barthii* A. Chev. Incidentally this same cultivated rice extends to the dry belts of the Gold Coast and Nigeria, where it is grown under swamp or semi-swamp conditions. Inter-sown with hill rice are types of guinea corn (*Sorghum margaritiferum* Stapf) and of millet (*Pennisetum leonis*, Stapf & Hubbard), which have been developed to suit the very high rainfall, and are sufficiently late in maturing to ripen in the dry season following the monsoon. The wet-land rice of the Scarcies, the cultivation of which in recent years has made such rapid expansion, is now confined to Asiatic varieties.

[PARA. 91

Pagan women preparing "Acha" (Digitaria exilis) flour by pounding, winnowing and sifting, near Zonkwa, Northern Nigeria

[PARA. 93

The hand hoe used in the Pagan country near Zonkwa, Northern Nigeria. This pattern, with the short handle almost parallel to the blade, has been evolved for work in light sandy soil. The continuation of the blade into a long iron spike is peculiar to this part of Africa

Of the introduced crops cassava is planted in the hill-rice clearings before the land reverts to bush, and sweet potatoes are often grown as a dry season crop on raised mounds made in the inland swamps. New World cottons of the *Barbadense* type are commonly grown around the house compounds. In hill clearings Lima beans are trained over cut poles set up in wigwam fashion. In the colony cowpeas are grown, but they are said to be a fairly recent introduction from Nigeria.

85. Agriculture in the Gambia pertains more to that of the dry north than of the Middle Belt, and is based on the cultivation of dry cereals, with groundnuts as a money crop, and with a certain amount of swamp rice, which is entirely a women's crop. The types of farming here are rather more diverse than elsewhere owing to the drift of various tribes from the east having been checked by the sea.

CHAPTER IV

TYPES OF WEST AFRICAN AGRICULTURE

86. The standard of farming evolved in different parts of West Africa depends largely on the density of the population and also on the amount and distribution of the rainfall. Where the amount and distribution of rainfall render crop production certain, one generally finds the standard of farming lower than where the rains are apt to disappoint and where there is only one season for crop production.

Agriculture of the Pagan Tribes

87. The indigenous African is an excellent judge of soil, and the pagan tribes both in Nigeria and the Gold Coast have settled in areas where the soils are considerably above the average. In the Gold Coast their farms are practically confined to the soils on granites, while in Nigeria they are concentrated on or around the Bauchi Plateau, where the people have sought out the soils derived from intrusions of basic rock. Friction has several times arisen when Nigerian Administrative Officers have tried to move these people from these hillside lands to valley sites, which, according to the old text books, might have been expected to be more fertile. The hill pagans knew better, and now Europeans in Jos and elsewhere are sending to these spots of basic rocks for soils to make gardens.

88. Both in Nigeria and the north of the Gold Coast the standard of the pagan agriculture is higher than in the surrounding country. In the North Mamprusi region of the Gold Coast the occupied land is under permanent farming, though the owners may also have bush farms at a distance from their homes ; the same applies to some extent to Nigeria. In both regions the people live in small compounds in the centre of their holdings. Those in the Gold Coast are family holdings, while in the plateau region of Nigeria the dwellings are more concentrated, presumably for purposes of protection in former times. In both regions the people make use of animal manures mixed with household ashes. The Gold Coast pagans are more fortunate in that many of them keep cattle and, in addition, make a considerable income from the sale of poultry. Both here and in Nigeria every compound keeps goats. The main fuel is cereal straw, which may be supplemented by any wood available.

89. At the foot of the Bauchi Plateau we had an opportunity of seeing one of the compounds. The dwelling huts were arranged in a circle together with a larger hut in which the live stock were enclosed at night. In the centre were the communal granaries. All ashes from the houses and the open hearth in the centre of the compound were thrown into the live-stock pen, to be incorporated with the droppings of the animals and returned to the land. It was noticeable, however, that most of the manure was concentrated on the lands immediately adjoining the compounds.

90. Unfortunately we had no opportunities of investigating the cropping on the plateau in Nigeria, but we were able to see the crops grown in the neighbourhood of Kafanchan and Zonkwa. According to our standards the people are primitive. The women wear no clothes, except a few leaves held in place by a thong girdle, and one presumes that before work was available in the tin mines on the plateau the dress of the men was also more ornamental than useful. Their agriculture consists almost entirely in the production of food-stuffs, the only economic crops we saw being gourds and a little tobacco. In the immediate neighbourhood

of the compound there were a few garden crops such as okras, a species of *Solanum*, probably a primitive form of *S. melongena* L. with bright red fruits, and a few chillies and tobacco. Near at hand, too, would be a patch of land worked into wide mounds intersected with drains. This was intended for yams, but in the meantime a few plants of gourds had been established along each mound. A little farther away were crops of sorghum and invariably a fair extent of Lima beans. This latter was grown as a pure crop, and much trouble had been taken to provide poles on which the beans could climb.

91. On the lands farther from the village a distinctive type of grain pennisetum is transplanted on well-made ridges. The seed is always sown in a seed bed and the seedlings are transplanted singly. The plant never tillers, and thus forms a single head of grain. In among this crop seed of roselle are sown. This also appears to be a distinctive variety of a deep red colour. Other fields are planted with guinea corn, of which the people have two varieties, one said to be indigenous and the other, a loose-headed type, comparatively recently introduced. Each year one of the fields after bush fallow is sown with " Acha " (*Digitaria exilis*), a very small-grained indigenous cereal. Though it does not give a large outturn it is the first cereal crop to be harvested, and is therefore available at a time when other cereal grains may be exhausted, for, like many primitive African tribes, these people are improvident. Beniseed (*Sesamum orientale* and *S. radiatum*) is usually grown in small patches as an oilseed, but the people also use the seed of an arable land weed, *Guizotia scabra*, for this purpose. In addition to these settled lands the compound generally has a small area of cultivation along the banks of the streams, where the fringing forest has been allowed to remain. Here are grown root crops, such as Colocasias, Alocasias, Xanthosomas, as well as okras, vegetables, plantain, and occasionally banana. It is on these lands that, under encouragement from the Department of Agriculture, the people have recently taken up the cultivation of ginger (*Zingiber officinalis* Rosc.), which is being grown for export as the only cash crop. At the time of our visit the Department of Agriculture was concerned about the difficulty of maintaining the standards for ginger laid down for the British market. The root, when freshly scraped, has an unattractive grey-brown colour, and it is necessary to bleach it. This is done by soaking in water and exposing it to the sun. The process is repeated until the ginger is white. If the soaking is too long, or too often repeated, an excessive amount of the water-soluble ingredients is removed, and the sample does not come up to the standard established for dried ginger. This problem illustrates the difficulty of combining even simple technical operations with the agriculture of a primitive people. Where it is hoped to establish a new crop, everything should be done to simplify the preparation for marketing. The Ministry of Health in Great Britain might be approached to obtain permission for the export firms to bleach the dried, scraped ginger by sulphur dioxide, a method formerly employed in Southern India for the Malabar and Cochin ginger crop.

92. On the plateau regions the principal cereal is " Acha," but considerable areas of the same type of grain pennisetum, described in the preceding paragraph, are also grown. Here, however, the system of cultivation is different. The land is thrown up into large mounds, on which a few plants of the cereal are transplanted. Whether this method is adopted to check soil erosion or to produce a depth of well-drained surface soil is not clear, but it seems to entail an extraordinary amount of labour for very small returns. On the plateau one sees a fair acreage of cassava, probably introduced as an insurance against locust damage. The plateau is quite different from other parts of Northern Nigeria and resembles the short-grass veld of parts of the Union of South Africa. It is an inhospitable country, and one can only imagine that the pagan tribes have been driven up into these highlands during some previous era and have had to make the best use they could of their surroundings. Soil erosion might be severe if a larger proportion of the land was cultivated. Near the villages stone-wall terraces have occasionally been built and the fields levelled.

93. The agriculture of the pagan tribes in the Mamprusi area of the Gold Coast has been fully described in Bulletin 34 of the Department of Agriculture, Gold Coast. In general, their method of management is similar to that of the pagans of Zonkwa in Nigeria, except that their crops and varieties may differ. Both early and late varieties of grain pennisetums are grown, but not " Acha." Cowpeas, Bambara groundnuts (*Voandzeia subterranea*) and *Kerstingiella geocarpa* take the place of Lima beans ; melons are interplanted among the grain pennisetums

for the sake of their seeds ; "Hausa potatoes" (*Coleus dysentericus*) and rice are grown in low-lying lands. The region is too far north for yams to prove successful.

94. The weak point in the agriculture of all these pagan peoples is their improvidence. A year of good crops and surplus food supplies tends to lessen the area under cultivation in the following year, or else the work is done too late in the season to give the maximum yields. Though they realise the value of organic manure and may take trouble to conserve their supplies, they generally apply it to the land near their homestead ; the more distant lands never get manured. Certainly the amount of manure is insufficient to maintain the fertility of the whole holding, but it would give better returns if it were distributed more evenly. The Department of Agriculture is rightly concerned with increasing the amount of manure by encouraging the use of grass and wild growth as bedding.

Hausa Agriculture

95. The agriculture of the Hausa people is also good, but does not compare in intensity with that of the pagan tribes. The people know their soils, and know how to crop them and how to take full advantage of the rains. Their standard of civilisation is on a much higher plane, and their wants are therefore much greater. They all, moreover, come under the native administration of the several emirates, to whom they have to pay tribute either in kind or in money. The considerable urban population and the traders and cattle-owners provide a market for the sale or exchange of produce. For all these reasons a strong incentive exists to grow more food crops than would suffice for the family, as well as other crops which can be sold in the home or export markets. Recently the possibilities of supplying the markets of the south with some of their vegetable requirements has led to a cold-weather system of market gardening, though only on a small scale at present.

96. The Hausa system of farming has been evolved to give the best returns per unit of hand labour. The farmer and his family can cultivate between three and four acres with hand implements, but, as he has no live stock to provide manure, he lets his land revert to bush for fairly long periods to restore its fertility. Each year some fresh land is cleared from bush, and cropping is gradually carried round a total holding of four to five times the amount cultivated in any one year. He does what he can to maintain soil fertility, but his only source of manure consists of travelling Fulani herds of cattle, which come into the guinea-corn fields after harvest to feed on the leaves left on the straw. Their owners will sometimes pen the cattle on the land in exchange for a little grain.

97. The country hoe which has been evolved for cultivation is admirably adapted to its task. The blade is large and set at an acute angle with the handle, and is so constructed that a surface slice of soil can be cut, lifted and turned over to form a ridge almost in one action. The ridge is made to assist drainage in the rainy season and to concentrate the surface soil where the seed is to be sown. The inverting action buries and kills the weeds. The ridges are not continuous, but every now and then run into each other, thereby holding surface water till it has time to sink into the ground.

98. The two main cereal crops are guinea corn and grain pennisetums. Of the grain pennisetums there are two types ; one, known as "gero," is the early millet, sown at the commencement of the rains, harvested within about three months, and followed by guinea corn, which is sown in the standing millet crop. The other is a long-duration or late millet, known as "maiwa," which is grown without other cereals but invariably under-planted with cowpeas, of which there are several well-known varieties. Around the dwelling-house, where human habitation has enriched the soil, there are various crops, such as okras, chillies, gourds, tobacco and "Rama" (*Hibiscus lunariifolius*), which supplies leaves for a vegetable and a bast fibre for rope making.

99. Scattered through the cultivation are large trees of shea butter (*Butyrospermum parkii* Kotschy) and "durowa" (*Parkia filicoides* Welw.). Under the shade of the latter one sometimes sees crops such as coco-yams, chillies and cotton.

100. We may mention that on several occasions, notably at Bakori, the cotton was better and the soil darker in colour under the "durowa" tree than in the open clearings. This spreading leguminous tree casts a thin shade over a wide area, and by its leaf-fall adds organic

matter, nitrogen and other nutrients. Additional amounts may be brought in during the bush period by goats which seek the shade in the heat of the day. This method of manuring and shading soils might well be developed.

101. Cotton has always been a money crop in the Hausa country. Formerly this was either an indigenous Old World cotton or an early introduction (*Gossypium punctatum*). These were generally grown as perennial crops, as they still are in certain out-of-the-way places. They have, however, been almost entirely replaced by an American upland cotton, " Allen's Long Staple," which has been introduced and acclimatised since the beginning of this century. This is grown as an annual crop and has found its place in the rotation. It is usually grown alone after an early millet crop on land broken up from bush fallow. The internal price for cotton, which is spun and woven locally, is often much above the export price, though the demand is limited and is soon met.

102. Since the country was opened up by railways, groundnuts have also become an important cash crop, especially on the lighter soils within easy reach of the railway. Groundnuts may be grown farther away if the export price is sufficient to pay for the extra haul by lorry, but a sudden fall in prices may prove disastrous to the more remote farmers. In 1938-9 some of them received less than ten shillings per acre, and it was commonly stated that much of the crop would not be lifted. On some very light soils around Duara steps should be taken to discourage frequent cropping with groundnuts. As the ripe plants have to be hoed out, the soil is left in a loose condition during the dry season without protection against wind and early rains. We saw fields in which loose sand had been blown up into waves and piled against the remains of hedges and field boundaries. Near the big towns there is no need to grow export crops, as there is always a market for cereal and pulse grains and also for any guinea corn and millet stalks which are not required for repairing the roofs of houses and compound fences.

103. Thus locality and environment exert a great influence on crop rotations and their constituents. It is not therefore possible to give typical examples of these, as can be done in regions where agriculture is merely on a subsistence basis. The fact also that groundnuts and cotton are generally grown in pure stands eliminates mixed cropping, which is such a general feature of West African agriculture.

104. The agriculture around Kano differs markedly from the general Hausa methods just described. Owing to the size and importance of the city as a centre of trade, there has been a tendency for much closer land settlement within a radius of some twenty miles. It became necessary to keep a larger proportion of the land under cultivation, and much of it is in fact permanently farmed. This has been rendered possible by using the manure accumulating in and around the city from the pack-oxen, donkeys and camels which bring in the bulk of goods and produce. It is a common sight to see donkeys with panniers carrying this manure out to the fields.

105. A new system of " mixed farming " has been developed by the Department of Agriculture. This method will be fully dealt with in Chapter VI. Here it is sufficient to state that it has been rendered possible by the work of the Veterinary Department in immunising stock against the dreaded scourge of rinderpest, which in the past has often decimated the Fulani herds. The nomadic Fulani jealously guard their ownership of breeding cattle, and it is almost impossible even for the Government to purchase female stock. When the majority of the female stock are immune from rinderpest, and growing stock can also be immunised, this prejudice may break down, and the Hausa farmer may then be able to use cattle freely for cultivation and for making manure under the new system of mixed farming.

106. In the Hausa country another very restricted type of farming is conducted in the " fadamas " or swamps, often in conjunction with ordinary dry-land farms. Sugar cane for chewing is grown in the country districts, and cold-season vegetables near the towns. The rest of the swamps are occupied by coarse grass, reeds and rushes. Much more use could be made of these lands for sugar cane and for the green foods which are at present very scarce during the dry season. Much has been done in the dry climates of French West Africa to develop vegetable production. The French are adepts in this class of work, but there is no reason why their example should not be followed in what are less trying conditions in Northern Nigeria. It is possible also that where these fadamas contain perennial supplies of water, minor irrigation

[PARA. 93

Family compound of the Pagan tribes in the Mamprusi area of the Gold Coast, with bundles of millet straw and fuel and a baobab tree in the background

[PARA. 96

Hausa homestead, Northern Nigeria

works may ultimately prove of benefit to the country. The regulation of these fadamas and the fringing bush should also do much to lessen the incidence of tsetse fly and the trypanosome diseases which attack both man and stock.

YORUBA AGRICULTURE

107. If, as has been suggested, the Yoruba people came originally from Egypt, there is little evidence of this in their agricultural practice of to-day. They may have brought with them a few subsidiary crops, such as Jew's mallow (*Corchorus olitorius* L.), which is still grown as a garden crop for the sake of the leaves, but the cultivation of the ordinary field crops is typical of the African negro. It is probable therefore that the original immigrants took to themselves wives of the country, who continued their time-honoured method of agriculture to support themselves and their families ; or it may have been a more gradual process, in that the conquering incomers made the people grow their food supplies for them.

108. The Yoruba is much more of a town dweller than the other people of West Africa. Their towns at the present day are very insanitary, especially the smaller ones which do not come within the reach of the sanitary authorities. Many Indian villages are bad in this respect, but the people are largely vegetarian, and the village buffalo acts as a scavenger. The surroundings of a small Yoruba town are much worse, as the people are omnivorous and have no suitable live stock for scavenging. Ibadan, with a population estimated at 387,000, including the farming suburbs, is said to be fed from the surrounding country to a radius of some twelve miles. When one thinks of the enormous supplies of food needed for such large centres, and considers that no manure is returned to the more remote fields, it is amazing that agriculture can be continued with a fairly high standard of soil fertility. The immediate surroundings of these towns are of course immensely rich from the night-soil deposits of generations, and here the people grow such garden crops as chillies, garden eggs, tobacco, okras. This shows that they realise the effects of natural manuring, though they are not prepared to improve their bush farms by carrying manure from the village or town.

109. The general agricultural practice on the bush farm is to clear and burn the bush growth, leaving a number of small poles as subsequent supports for the yam vines. The land is then made up into heaps or ridges in which the seed yams are planted during the dry season. With the early rains in the ensuing spring maize is planted on the lower slopes of the yam hills, with cowpeas and a few odd plants, such as cotton or roselle. The maize stalks are generally left to support the yam vines. After the yam crop is harvested a late maize crop may be sown, which again is underplanted with cowpeas, and in the following year cassava is planted in the old yam heaps, mixed with maize, cowpea, Lima beans, yam beans, etc., the last two being trained on living poles. The cassava is the last crop to be harvested before the land reverts to bush. As three important crop plants included in this rotation belong to the New World, viz., cassava, maize and Lima beans, one wonders what the state of this country would have been to-day without these important additions to help out the yam crop. As yams are always planted on land freshly cleared from bush one can realise that, with the present population to feed, very little bush worthy of the name would now remain.

MUNCHI AGRICULTURE

110. The Munchi is another example of an invading race who married the women of the country they conquered. They are said to have settled here within the last century and to have come from the south. The use of camwood for dyeing their garments, and the custom of ornamenting their bodies and faces with raised cicatrices, suggest that they came from the Congo region. The men are hunters rather than farmers. Each wife has to have a certain number of yam heaps prepared and planted for her—a not inconsiderable amount of work. The women are responsible for weeding the planted yam gardens, and on the slopes of the heaps they plant various subsidiary crops, such as cotton, Bambara groundnuts, and roselle, as well as a fibre crop (*Polygala butyracea*). Though this last is known as a wild plant in other parts of West Africa, nowhere else is it cultivated. As the fibre is sold to the fishermen of the Benue and Katsina Rivers for making their lines and nets one can infer that the crop was grown in this region long before the Munchi invasion. In the year following the planting of yams, cereal crops of guinea corn and pennisetum are planted on the old yam heaps, and underplanted with cowpeas ; in the third year the yam heaps are levelled down and sown with

beniseed, after which the land is allowed to revert to bush. The growing of beniseed was formerly, one presumes, on a small scale to supply local requirements, as it still is in the pagan country, but its more general cultivation has been encouraged by the export trade, and it is the only money crop in the area.

111. An invasion of locusts could have hardly been more destructive than the agricultural practice of this area. As the main food crop, the yam, is grown on freshly cleared bush land, the increase in population under British administration has led to a shorter period of bush fallow between successive crops. The bush has deteriorated by constant clearing, and the natural bush regeneration has been insufficient to supply the fuel requirements of the people, who have even grubbed up most of the tree roots to supply their needs. The result has been that this area, which ten years ago was fairly well covered with bush, is now an almost pure stand of "spear grass" (*Imperata cylindrica* Beauv. var. *Thunbergii*) or, as it is known in Malaya, "Lalang." This grass is almost impossible to eradicate from cultivated fields. The women have great difficulty in keeping it in check in their yam gardens, and the following crops in the rotation have a hard struggle for existence. There is little doubt that if they were left to their own resources the Munchi would move out of this area, which they have made almost uninhabitable and of little value for hunting. As long as the people base their agriculture on the yam crop they will continue to clear the land too frequently. There is much to be said for introducing cassava as an alternative root crop, which can be planted at the end, instead of the beginning, of a rotation. This would probably have the effect of reducing the beniseed crop, but this might be beneficial. Beniseed has the reputation in India of being an exhausting crop, and if, as has been suggested by McCulloch, it takes up relatively large amounts of lime and phosphorus it may so impoverish the soil as to limit the yields of other crops.

112. The fuel position has now become so serious that the Forestry Department has had to plant up communal fuel reserves of *Cassia siamea* Lam. to supply this want.

Agriculture in the Ibo Provinces

113. The Ibo population is over three million, second only to the Hausa of the north. They occupy a much smaller area of country than either the Yoruba or the Hausas, being confined to the Onitsha, Owerri and part of the Ogoja Provinces, east of the River Niger. The density of the population is always high, and in some places reaches 1,200 to the square mile. From this one would naturally infer that it was a fertile country, but this is decidedly not the case, as most of the area has a deep reddish sandy soil of low natural fertility over Benin sands. The well distributed rainfall, however, allows crop production at most times of the year. Further, the oil palms yield an unfailing supply of oil. This is rich in vitamins and finds an overseas market, though hardly a profitable one at the time of our visit. One of the main reasons why such a large population can be supported is that the country is sufficiently near the coast for the people to trade their palm oil for dried fish.

114. The country reminded us of the Malabar and Cochin coasts of India, except that it is flatter and lacks the rice fields which are a common feature of those countries. The people of both countries live in scattered compounds near their palms, though in India the coco-nut and areca-nut take the place of the oil palm and raffia. The Ibo country lacks not only the mango but the jack fruit, which on the west coast of India furnishes a valuable food supply for two or three months in the year.

115. The Ibo families live in large compounds, within which they grow various root crops, beans and cucurbits in soil enriched by ashes and excreta. The principal crops are Colocasias, Alocasias, Xanthosomas, Lima beans, yam beans, *Telfairia occidentalis*, Hook. f., and various spinach plants. Beyond the compounds are the lands of the clan, which are in general communally farmed. These are poor in the extreme, as everything is removed and nothing returned. The traditional crop is the yam, but at the present day this is grown more as a matter of prestige than as the staple food. Owing to the impoverishment of the soil it has been largely replaced by cassava. Were it not for the well-distributed rainfall, natural bush might have disappeared long since from these lands. Even as it is, the people are encouraged in their own agricultural practice to replace natural bush by planting a small rosaceous tree known as "echeku" or "araba" (*Acioa barteri*). Anyone who elects to plant this tree on a given area

is allowed to crop that land for his own requirements, subject to the right of the community to take it back for a public purpose. This small tree has a very deep tap root, and coppices readily. The practice is to allow it to grow for a few years and then to cut it down and burn the branches, leaving only those required for yam props. The land is then prepared for a crop of yams, followed by cassava, or of cassava alone if the land is not very rich. The echeku is allowed to coppice again until it is sufficiently grown to warrant re-clearing. We noticed that this tree had checked gullies in badly eroding country, and that the few roots exposed had penetrated to very great depths. Presumably it brings up plant nutrients from these depths and thus enriches the surface soil.

116. If the present density of population in the Ibo country is to be maintained, and the land hunger satisfied, it will become essential to devise means for increasing the productivity of the land. This country, and the Munchi one just considered, presented the most difficult agricultural problems encountered during our travels in Nigeria. Only after a dozen years of unremitting devotion by the agricultural officers was there any appreciable response from the heads of the local clans, but useful contacts have at last been established and some confidence inspired.

CHAPTER V

PLANTATION AGRICULTURE

117. The policy regarding plantation agriculture differs under different colonial administrations. Generally speaking, in the British dependencies the African has been encouraged to develop plantation agriculture, while in the former German colonies the main development was by means of European estates employing African labour. In the French territories both European settlers and Africans have been encouraged to develop plantation crops. These several policies have been largely governed by local circumstances. In the densely populated parts of Nigeria and the Gold Coast, where there was little opportunity for large-scale plantation agriculture, and in other parts where the African had shown initiative he was naturally left to develop his own country. In the Cameroons and in large areas of French West Africa the population is relatively sparse, and there is room both for African and European plantation enterprise, which is good so long as it is kept under proper control and an adequate food supply is ensured. In the Mandated Territory of the French Cameroons the granting of land to European settlers is in abeyance for the time being, because it would be impossible to supply new settlers with sufficient labour without interfering with food production. The Administration, therefore, is concentrating on sanitation and welfare services so as to build up a population able to develop the natural resources of the country.

Nigeria

118. The present policy in Nigeria is not to allow of any further alienation of land to Europeans for plantation agriculture. This, however, has not always been the policy. When the Royal Niger Company, a Chartered Company of the amalgamated British trading companies, administered the coastal provinces of what is now known as Nigeria, there was a bias in favour of introducing plantation agriculture to assist the trade of the coast. With this in view, a public botanical plantation was opened at Asaba in 1888 to supply seeds and plants to both African and European settlers and cultivators. In the two following years further plantations were started for cocoa and coffee at Abutshi, N'Kissi (Onitsha), Appakka, and the Creek. The one at N'Kissi was on a considerable scale, and in 1905 yielded a crop of 38,000 lbs. of coffee, of which some ten tons were prepared for export.

119. In the colony of Lagos a botanical station was started at Ebute Metta in 1887, and another by the Oil Rivers Protectorate at Calabar in 1893. These did useful work in introducing new or better types of economic plants, such as exotic species of rubber. In 1899 a " model farm " was started at Ibadan, chiefly for the propagation of " Funtumia " rubber trees. This was situated in the Forest Reserve, and subsequently, when a Director of Agriculture and Forests was appointed, it was handed over to the Forestry Department. In 1902 another " model farm " was opened at Oloke Meji, 93 miles north of Lagos, as a development of the botanical station at Lagos. It will be seen, therefore, that the early administration

of Nigeria was as much interested in opening up the country by European enterprise as in assisting the African to improve his status by growing cash crops for sale to exporting firms. In fact, Sir Walter Egerton, who had seen the initial successful developments of rubber in Malaya before he was transferred to Nigeria, arranged in 1904 for a grant of land to be made to the companies to grow Hevea rubber, and for the introduction of Hevea seed from the Federated Malay States. The existing rubber industry of Nigeria, which is represented by two European plantations and numerous small African-owned plantations in the neighbourhood of Benin, is doubtless the result of his efforts.

120. Within the last twenty-five years there have been remarkable developments by Africans in the planting of cocoa for export in the south-western corner of Nigeria, and of cola for Northern Nigeria. Ten years ago the imports of cola nuts from Sierra Leone was a considerable item in coastal trade, but now it has entirely ceased. One sees cocoa farms in all stages of prosperity, from the well-cared-for plantation of the resident owner to the neglected plantation of the absentee landlord. It is difficult to foresee the future of this cocoa industry. It would seem that these lands have not much lasting fertility ; when once the canopy is broken and the soil exposed to sunlight, the plantation deteriorates rapidly, until it no longer pays to expend labour on upkeep.

121. There has been a considerable expansion in the plantation enterprises of The United Africa Company. Except for the existing rubber plantation at Sapele, all development has taken place within the last few years. Two estates of 3,000 acres each have been planted up on leased land near Calabar. One is entirely oil palm and the other is half oil palm and half budded rubber, while the Sapele plantation has been extended to 3,000 acres by planting up oil palm. The company have also two plantations in the British Cameroons ; the one at N'Dian is a former undeveloped German estate, which has now been planted up with oil palm. This has been extended by a further grant of land made under certain conditions, one being that " the estates were to be the means whereby possible improvements in palm culture will actually be tested on a large scale and demonstrated to the natives in a convincing manner." Clearly the most important needs were the selection of palms for seed purposes and the supply of seed as required to the Nigerian Department of Agriculture. These conditions have been faithfully kept, and have materially assisted in the development of seedling oil-palm plots by Africans in the Eastern and Benin Provinces of Nigeria. The N'Dian plantation is in a very sparsely inhabited part of the country and employs a considerable labour staff, voluntarily recruited from the more densely populated areas of the Eastern Province of Nigeria. A total of 5,000 acres of oil palm has been planted, and most of it is now in crop. No attempt is made to grow food-stuffs on the plantation, partly because the full area available is said to be needed to make an economic factory unit and partly because the purchase of food-stuffs in the Calabar district constitutes a mutually useful form of trading. Another enterprise of this company is a banana plantation of 400 acres in the neighbourhood of Tiko.

122. In the Mandated Territories of the British Cameroons all accessible land on the rich volcanic soils surrounding the Cameroon Mountains was alienated for estates in the time of the German occupation. An enormous amount of labour and capital must have been employed in opening up and planting these areas. Every estate seems to be furnished with light railways for bringing produce to the central factory, where it could be prepared for export. Except on the more level lands near the coast, and in the neighbourhood of Tiko, none of these plantations showed any signs of prosperity at the time of our visit. We formed the impression that the owners had not made up their minds what crops to grow. They had cocoa, oil palms, Hevea rubber and a certain amount of Funtumia rubber. The Hevea rubber was certainly being tapped, but much of the cocoa was being uprooted and replaced by oil palms, while many of the oil palms were being uprooted and replaced by cocoa. The only crop which appears to pay is the banana. This is the " Gros Michel " banana of the Caribbean region, and as long as the fruit can be brought to the loading steamer, either by barge or by not too long a haul by light railway, the industry is seemingly very prosperous, and is now sufficient to keep a fleet of some six fast steamers, specially built for the trade, busy for some seven to eight months of the year. The crop, however, is only profitable on these volcanic soils. As soon as plantings extend beyond these, the size of the bunch and the number of hands render them unsuitable for export.

[PARA. 98

Typical Hausa compound with tobacco in the foreground, Northern Nigeria

[PARA. 100

Cotton growing luxuriantly under the protection of the light shade of the durowa tree

123. One cannot help admiring the efficiency with which these plantations are carried on. They are not so luxuriant, perhaps, as the best plantations on the Caribbean mainland, but a large proportion of the bunches are suitable for export, and those which are not suitable are made into dried bananas or banana figs, for which there is apparently a good market in Germany. Drying bananas was tried in the early days of the Jamaica industry, but the banana figs never found favour on the British market in spite of numerous sample consignments, and the industry came to an end when the transport of bunch fruit was developed.

124. A certain amount of cocoa is grown by Africans north of this volcanic area, but the crop is difficult to cure in this region of heavy rainfall. A considerable amount of work has, however, been done by the agricultural officer at Kumba in organising co-operative curing on specially heated curing yards, and in co-operative marketing. More than one of the societies now have their own motor transport.

The French Cameroons

125. Plantation products receive special advantages in the French territories. Preferential prices are secured in France and financed by import duties on similar products grown outside the French Empire. Thus the French have been able to build up a considerable industry in coffee. The type grown in the French Cameroons by Africans is laid down by decree, and strictly controlled to ensure as far as possible a uniform type of bean. The preparation for the market is conducted by co-operative societies, and the marketing is also strictly controlled. In suitable areas of comparatively high elevation *Coffea arabica* L. is grown, but this industry is entirely in the hands of French settlers.

126. In the French Cameroons there must have been considerable estate development in the time of the German occupation. One sees along both sides of the railway running from Duala to Yaundi vast areas of practically pure stands of the umbrella or parasol tree (*Musanga smithii* R.Br.), which in these moist tropical areas springs up spontaneously wherever the ground has been cleared. Since the French authorities consider that, for the time being, a limit has been reached in European settlement on account of labour shortage, one wonders how the Germans were able to keep such large acreages under plantation development. It would appear that this could only have been done by some system of forced labour.

127. The trunks of the umbrella tree split easily into planks, which are used extensively for building the walls of native houses. They form an admirable substitute for wattle and daub, which would be difficult to preserve in the heavy rains experienced here.

The Gold Coast

128. In the Gold Coast the principal plantation crop is cocoa, which is said to have been originally introduced in 1879 from the island of Fernando Po by a Gold Coast native who had been working there. Later, under Government auspices, other successful introductions were made from San Thome and elsewhere. It is amazing to see how readily the African has developed this purely export crop within a comparatively short time. The rise of production has been phenomenal, exports having risen from 80 lbs. in 1891 to over a quarter of a million tons annually in the nineteen-thirties.

129. It is also worth noting that the methods adopted for establishing these plantations compare very favourably with and are very similar to those employed on European estates in other tropical countries. One hears criticisms sometimes of the closeness of the planting, but this seems to be rather an appreciation of the low fertility of the soil, the closer planting being generally more apparent on the poorer classes of soil. During the short time at our disposal it was not possible to assess the alleged deterioration of the cocoa farms. In the Eastern Provinces wholesale clearance of the evergreen forest for cocoa has undoubtedly led to drier climatic conditions, in which the cocoa plant is more liable to deteriorate. Here one sees considerable areas of apparently abandoned cocoa. Where the canopy formed by the cocoa tree is broken, the soil is exposed to the sun's rays. Bare patches in a plantation soon spread, the surrounding cocoa dies, and even the large shade trees, which have been left here and there throughout the cocoa farms, show signs of rapid decline. Formerly it was a common practice for owners of cocoa farms to employ men from the Northern Territories, who were paid by a share in the crop. Since cocoa prices have been so low there is little inducement for these

immigrants to work on the cocoa farms, especially as regular wages can be obtained in the various gold and diamond mines, which have expanded their workings greatly in recent years.

130. The Gold Coast has in the past created much wealth by its cocoa crop, which in its turn has given rise to a much higher standard of living. Hence the country has become a valuable market, more especially for food products from surrounding countries. There are considerable imports of cattle for slaughter from Nigeria and the Cameroons, in addition to those coming from the north. There is a thriving poultry industry in the north of the Northern Territories and the adjoining French territory, with a continual stream of lorries taking live table poultry down to the towns in the cocoa regions. There is also a considerable lorry traffic all the way from the Niger River, in the French Sudan, bringing fish products a distance of over 800 miles. Besides this there are large imports of ordinary food-stuffs from surrounding territory. The African cocoa farmer has preferred to purchase food with the money he receives or can raise by mortgaging his crop or his farm.

131. The value of money was not properly appreciated in the Gold Coast in the years of good prices. A few years ago wages for manual workers were high, and it is not surprising, therefore, that European estates and enterprises are not more in evidence. There is one small estate under European management about 30 miles west of Secondee, with some 350 acres of rubber in tapping, and also limes and bananas. At Bunsu, in the Eastern Province, there is a 1,000-acre cocoa estate, planted by the engineer of a gold concession and since abandoned. It now belongs to The United Africa Company, which has recently handed it over to the Achimota College for training African youths in plantation agriculture. This estate was, until eleven years ago, in the charge of a European, but it is now in a dreadful state. Secondary forest growth has choked out the cocoa from large areas. Where the canopy has been maintained there are said to be stands of quite good cocoa. The United Africa Company also have an oil-palm concession at Sesi, 25 miles west of Secondee, with a central factory connected by light railway to coastal groves of wild oil palm covered by the concession. There has, however, always been difficulty in getting the people to cut and carry the fruit, owing to the low money return compared with the wages in the cocoa farms when prices of cocoa were high. Now people are said to be no longer willing or able to climb palms and cut fruit. The factory manages to keep going, but not on a full scale, by employing native immigrants from the palm belt of Nigeria. Recently, planting trials on a small scale have been made with seedling palms raised from selected seed from N'Dian. These are now in bearing, and appear to the management sufficiently promising to warrant an extension of planted oil palm. A thousand acres have been cleared for planting, but, unfortunately, sufficient seedlings are not available, and much of this area will have to be re-cleared before it can be planted.

Sierra Leone

132. In Sierra Leone climatic and vegetation conditions are unsuitable for cocoa, except in a small area in the extreme east of the Protectorate. The Department of Agriculture has been encouraging the cultivation of coffee of the Excelsa type by Africans, but it is unlikely that this will prove a very remunerative crop without some form of protection, since it cannot compete with other areas within the Empire where Arabica coffee can be grown. The Government of Sierra Leone took the initiative in planting oil palm on an area of 4,000 acres at Masanki some ten years ago when the finances of the colony permitted such expenditure. Since that time, however, revenue has suffered severely from the world depression, and the plantations were practically abandoned for some seven years. In the meantime the young palms were threatened both with the danger of fire and suppression by grass and forest growth. The plantation has now been leased to The United Africa Company. An up-to-date factory has been erected, with a European in charge. About half the area had been planted with Nigerian seed and half with local seed. The whole of the former area has now been cleared, and most of the palms are in bearing. They still show the effects of previous neglect in their slender appearance and low cropping value. Much of the area from local seed has also been cleared, but the palms are poorly grown and do not seem to give fruit of economic quality. Much labour is needed to prevent fires, especially where the railway runs through the estate.

133. Another interesting plantation development is being tried at Songo by a Syrian merchant. This is the cultivation of the Canary Island banana (*Musa cavendishii* Lamb.).

The method of growing this crop has been copied from the French settlers in French Guinea. A valley swamp is selected, drained, levelled and trenched to a depth of one metre. On this prepared land bananas are planted two and a half metres apart. After the plants are established, they are mulched with green brushwood to a depth of a foot, and on top of this a foot of cut grass is spread three times a year. The cultivation is very costly, but the banana plants looked most promising, and French experience suggests that an established plantation will last for at least seven years and possibly longer. Even if such areas cannot be subsequently replanted with bananas, there is no reason why the land should not become valuable rice land. It has been levelled and drained, and the water which naturally flows down the valley swamp might be used for irrigation. This seemed to be a most useful object lesson, and there is no reason why Africans with initiative should not be able to carry on similar plantations.

THE FUTURE OF PLANTATIONS

134. Except on the rich volcanic soils surrounding the Cameroon Mountains, it may be said that the commercial value of plantation industries in the hands of the European estates has yet to be proved in West Africa. Even on these volcanic soils it is evident that cocoa and oil palms cannot be made to pay at present world prices, and that the banana is the only profitable crop. Whether estates such as N'Dian, with the overheads distributed over a larger area, can be worked profitably at present world prices has also still to be proved. The oil palms on this estate are not yet in full bearing, and no definite estimates can be made as to the future annual income. It would seem that the real value of such estates lies in the knowledge gained and the services which can be rendered to the native oil-palm industry by The United Africa Company, which, being a trading company, depends to a great extent on produce grown by Africans. It is only on such large estates that selection of oil palms for seed purposes can be made on an adequate scale, and there is no doubt that Nigeria has benefited considerably by the able and willing manner in which the company's representatives have met the demands for selected oil-palm seed.

135. Selected seed, however, is not everything. Without adequate nourishment, no matter how inherently good the strain is, the palm cannot continue to produce large crops of fruit. The high yields per acre in the oil-palm plantations of Sumatra are undoubtedly due to the richness of soils derived from comparatively fresh volcanic material, which contains reserves of available nutrients in its unweathered minerals. Climatic differences may also be involved, for Sumatra has less cloud than Nigeria. But even on the richer soils of Sumatra fertilizers are now in general use, and it has indeed been said that the oil palm is regarded merely as a machine for converting fertilizers into oil. Until the last year or two no adequate series of experiments had been carried out in West Africa to ascertain the manurial requirements of the oil palm, or for that matter of any of the other plantation crops. Quite recently a series of fertilizer plots has been laid out on two or three of The United Africa Company's oil-palm estates, on a scheme drawn up by the Department of Agriculture, and this is now being supplemented by a much more ambitious series of plots on two of the estates. This second series is being carried out in accordance with the modern principles of field experimentation, under the general supervision of the Rothamsted Experimental Station. Phosphatic fertilizers have already been used over the greater part of the estates, but many questions remain to be settled before fertilizers can be used to best advantage. With a crop having only some fifty to sixty plants to the acre a very large area is required to provide sufficient trees and plots to afford reliable results. In the second series of experiments just mentioned a unit plot has forty-eight palms, and several of the experiments have 64 or 81 such plots. Clearly it would be extraordinarily difficult, if not impossible, to carry out such experiments on the irregular stands of trees of unknown history in native farms, and at the moment the Department of Agriculture has no appreciable area of palms of its own on which such experiments could be made. It would seem desirable, therefore, that the Department of Agriculture should arrange to share in running these experiments. The opportunities for co-operation are even greater in selection work on oil palm. A useful beginning has been made by the department in analysing the records from a few old trial plots and in multiplying the progeny from controlled pollination of some of these trees. The N'Dian and Cowan Estates have made a number of repeated selections from the so-called " Lisombe " strain, and are planting up several hundred acres with trees obtained from self- and cross-pollination. They have supplied useful material to

the Department of Agriculture. Accurate records will, however, have to be taken over a vastly increased number of trees, including many thousands of known crossings and selfings, before there will be much hope of finding really desirable stocks or of solving the more rudimentary genetic problems. The present position of oil-palm investigations in West Africa compares very unfavourably with that of the Belgian Congo, where the official Belgian Agricultural Research Service (I.N.E.A.C.) is doing admirable work at Yangambe under Dr. Beirnaert. Although European plantations have been encouraged in the Belgian Congo, and large areas taken up by companies which, like The United Africa Company, are associated with Lever Brothers & Unilever Limited, the main purpose of the Yangambe station remains that of developing a plantation system appropriate for native holdings. Whatever be the future policy of the Governments of West Africa on European plantations, the utmost use should at once be made of the opportunity the plantations provide for large-scale technical experiments, even if this means that the Department of Agriculture must accept some of the financial burden.

136. The preparation of oil for market still presents acute problems. Some twelve years ago it was believed that the only hope of improvement lay in the introduction of small central factories to which the producers could bring the fresh fruit. In this way it would have been possible to produce a high-quality oil low in free fatty acids. Unfortunately the necessary confidence could not be established, and producers tried to force up prices by withholding supplies. One of the plants designed for the purpose is still functioning near Takoradi in the Gold Coast, though it, too, is looking to its own plantations to ensure future supplies. Later, small-scale hand-operated presses were introduced. Some 500 Duchscher hand presses, costing about £18 each, have been purchased, mainly by petty traders, but their output remains a very small fraction of the total, and there is still great difficulty in obtaining a regular supply of fruit sufficiently fresh to yield a high-quality oil. The additional complication that the cracking of the nuts for palm kernels is regarded as the women's perquisite makes adjustments between buyer and seller more difficult. In the French Cameroons this obstacle checked the use of mechanical nut-crackers, which it was intended to send round with small mobile mechanical presses.

137. It would seem that progress in oil production must remain slow, but a useful beginning has been made in the small but steadily increasing demand for young plants. When the plantations around Calabar are in bearing, it may be expected that the people will realise the potentialities of properly cultivated oil palms.

138. At the moment the prospects of the West African oil-palm industry do not seem rosy, for the more efficient estates in the Far East have taken a rapidly increasing proportion of the world trade and already export more than the whole of Africa. Competition with whale and other oils has forced the price down to low levels, and it is very difficult for the Ibo to appreciate the significance of the world market. Even if the export trade decreases it must be remembered that the oil will remain an important local food-stuff, which will continue to be produced and consumed whatever happens to world prices. With the increasing prosperity of other potential consuming areas in West Africa the demand will expand. This could be encouraged by giving special rates on the railways. It may be that prices will rise sufficiently to arouse more interest and perhaps to allow an attractive bonus for superior quality.

139. As a general rule, it would seem that the cultivation of plantation crops in West Africa is best left in the hands of the African owner-producer. They have extremely small overhead costs, and can produce their own food supplies. In times of low prices they can continue to produce at a profit, whereas a European company would have to cut down its expenditure drastically, often to a point endangering the future prosperity of the estate. Of course, speculative absentee Africans may not be able to maintain their plantations in times of low prices. Ultimately it may be possible to secure some form of voluntary co-operation between producer, factory and Government with plantations worked communally under European supervision somewhat along the lines of cotton cultivation in the Sudan Gezira. At the moment this may seem a very long-range prospect, but it has to be remembered that the cocoa industry of the Gold Coast developed with phenomenal rapidity, and that considerable progress has been made in the co-operative preparation and selling of this crop. In any event, the problem does not appear more difficult than that of introducing the principles of local self-government to the Ibo, which has already been undertaken with an unexpected measure of success.

[PARA. 98

"Settled" Fulani compound on Katsina–Daura road, Northern Nigeria, with gourds and "Rama" in foreground

[PARA. 108

Fulani zebu cattle within Kano city, with a flat-topped hill, capped with laterite, in the background

CHAPTER VI

THE DEPARTMENTS OF AGRICULTURE OF WEST AFRICA

140. Before reviewing the work accomplished by the Departments of Agriculture and offering suggestions for future consideration, it will be convenient to trace some of the principal stages in the official approach to the development of colonial agriculture.

Types of Development in Tropical Agriculture

141. A brief survey of the tropical dependencies of the British Empire shows that they can be divided into four main categories. In the first group of countries with no significant native population, agricultural development depended on settlers from Europe employing imported labour for the performance of the actual field work. This group included most of the colonies in the Caribbean region, Bermuda, Mauritius and the Seychelles. The second group with a native population, whose needs were easily met by a restricted form of agriculture, consisted of Malaya, Sarawak, North Borneo, Fiji and the Mandated Territories of New Guinea, Papua, Samoa and other islands in the Pacific. In these countries there was generally scope both for European planting, often with imported labour, as well as for developing native agriculture as the needs of the people increased. Thirdly, there were territories with a well developed native agriculture and a native population, which was already dense or increasing rapidly through settled conditions of administration or large-scale irrigation schemes. With the exception of Ceylon and Cyprus these were in continental areas, and included, in addition to India and Burma, the British dependencies in Tropical Africa and the Condominium of the Anglo-Egyptian Sudan. In many of these countries, but not in West Africa, there was scope for European planting and farming in areas at high elevations, where for climatic reasons there was either no native population or only hill or forest tribes with little interest in cultivating land. Examples of such areas were the tea districts of India and Ceylon, and the highlands of Kenya, Tanganyika and Nyasaland. The fourth group, of little agricultural importance, consisted of small and usually isolated regions held for strategic reasons along the principal sea trade routes, e.g., Gibraltar, Malta, Aden, Singapore and Hong Kong.

The West Indian Model

142. The oldest colonies belong to the first group and lie in the Caribbean region. They were started in the time of the Stuarts, when some of the islands in the West Indies were granted as concessions to people having influence at the English Court. Here plantations were started for sugar cane, tobacco, cotton, cocoa and coffee, the labour being supplied by slaves from West Africa and by bondsmen deported from England for either political or criminal offences. In these early days, when the European demand for these commodities far exceeded the supply, plantation enterprise yielded very great profits, and little attention was paid to the local production of food-stuffs for the labour force. Certainly the slaves were allowed to grow their own " provision crops," such as yams, coco-yams, tannias, sweet potatoes and spinach plants, and seed of a few African food crops, such as guinea corn, pigeon pea, cowpeas and beniseed. It is a striking commentary on the shortcomings of the food ration that the African of the West Indies acquired a wide knowledge of the flora of these islands, particularly of species useful for greens, soups, " tea " and medicinal purposes. The bulk of the food was imported, and even at the present day there exists a prejudice against locally produced food-stuffs. In British Honduras, for example, the ration laid down by the Government for feeding labourers in mahogany camps consists of salt pork and white flour, while locally produced food-stuffs, such as maize, rice and sugar, are looked upon as inferior to similar products imported from abroad. It is not so long since it was a criminal offence to grow rice in British Guiana, as it was thought that its cultivation would interfere with the work on the sugar plantations. Rice with which to feed East Indian indentured labour was imported all the way from India and Burma.

143. As time went on the West Indian Colonies lost their virtual monopoly, especially for sugar, which had become, and still is, the most important crop in most islands. Sugar had not only to compete with other parts of the tropics, but also with the bounty-fed beet sugar on the continent of Europe.

144. Some of the island governments had for a long time maintained botanic gardens, from which promising economic plants were introduced from other parts of the tropics and

distributed to plantation owners. In this way the nutmeg industry of Grenada and the lime industry of Montserrat, Dominica and St. Lucia were started. It was felt, however, that something more was required to help the West Indian planter. An Imperial Department of Agriculture for the West Indies was therefore started for the smaller colonies, while the larger colonies, such as Jamaica, Barbados, British Guiana and Trinidad, established their own Departments of Agriculture. European officers of high standing were appointed, including entomologists and mycologists, to attend to plant diseases, which were rife in introduced crops owing to the scanty attention which these often received. Chemists were appointed to analyse soils and suggest manurial treatment, to investigate processing, and to analyse the juice of new seedling canes. Very scant attention, however, was paid to the production of local food-stuffs and to peasant agriculture. The West Indies still imports the bulk of its food, and endeavours on this costly system to compete with other parts of the tropics. It is only fair to say, however, that within recent years considerably more attention has been paid to local or maintenance agriculture. Rice, for example, has become the second most important crop in British Guiana, which can produce the whole of her requirements, with a surplus for export. Peasant agriculture now plays a prominent part in the work of many Island Departments of Agriculture.

145. Conditions in West Africa are very different from those which existed formerly in the West Indies. It belongs to the third category mentioned above. There exists an industrious agricultural population, who live on the crops they grow. There is at times a scarcity of food through climatic reasons and the improvidence of the people in not maintaining a reserve of food from one season to the next. The production of crops for export is therefore a secondary consideration, except where an appetite for luxuries has been whetted by easily earned money, e.g., from West African cocoa.

The Indian Model

146. There are many parallels between West Africa and India, and a short description of what has taken place in India, and its bearing on West African and especially Nigerian conditions, will not come amiss.

147. Europeans originally went to India, as to West Africa, for purposes of trade. Trading stations, generally forts, were established all along the coast by Portuguese, Dutch, British and French companies. The East India Company held its charter from the Crown, and so did the French East India Company. The rivalry between the different trading companies, especially when the British were often at war with the French, led to frequent clashes between the troops employed by these companies, often supplemented by regular troops from Europe and by those of the Indian rulers. Some Indian territories were conquered and the rulers of others were rewarded as allies of the British. The overthrow of the Delhi kingdom, which through its viceroys ruled the greater part of Peninsular India, meant taking over the administration of large parts of the conquered country. To provide the necessary funds the land revenue system of the Delhi dynasty was maintained, and was put on to a cash basis. The ownership of land was recognised, and it was soon laid down that no land in the settled districts was to be alienated to Europeans. Except in parts of Bihar, no land on the plains of British India has ever been so alienated. All planting enterprise has been in the hills. For such enterprises, as in the West Indies, labour had to be introduced, but this was a simple matter in India, where supplies of paid labour could always be obtained from the more congested parts of the country.

148. Even in the early days of The East India Company great interest was taken not only in the local crops but also in industries and manufactures, e.g., cotton goods woven in the country and often dyed and printed, sugar, pepper, etc. Government botanists were appointed to identify and study economic plants. Roxburgh's name is well known for his botanical research, and Buchanan Hamilton, also a botanist, is chiefly remembered at the present day for his very detailed economic survey of Mysore, South Canara and Malabar, which was carried out under the orders of the Company at the beginning of last century. The Company also expended large sums of money on agricultural enterprise. A spice garden was started in Malabar, with the object of breaking the Dutch monopoly. Seed of Bourbon cotton, for example, was imported freshly each year for a considerable time, and distributed to native farmers to grow. Some of it survives to the present day. Experienced American cotton growers were engaged and large farms were opened, both in Bombay and Madras, in an endeavour to

improve the yield and quality of the cotton crop. Dharwar American cotton is the survival of this effort. The Company was interested in the possibility of growing tea in the northern hills; it introduced seed from China, and tried out wild tea discovered in the Assam hills. The Royal Botanic Gardens at Calcutta were also established by The East India Company, as well as the gardens at Saharanpur.

149. After the Mutiny, when the administration of the country was taken over by the British Government from The East India Company, trade was separated from administration, the former becoming to a great extent a matter for the trading firms themselves. In the early days the Indian Government took the initiative in introducing various species of cinchona to combat the scourge of malaria, and a successful industry was established under Government control. It then financed the introduction of rubber-producing plants from the New World, and it was due to the enterprise of the Indian Government that the rubber industry of Malaya and Ceylon was founded. It will be seen that the attitude towards agriculture, both of The East India Company and the Indian Government, was very much the same as in the colonies.

150. With settled administration the population rapidly increased, and during the latter part of last century parts of the country were subject to severe famines. To relieve the situation fresh areas of land were made available for more intensive agricultural settlement by large irrigation projects, but it was then realised that something more should be done to improve indigenous agriculture. Agricultural colleges were started in some provinces and placed in charge of qualified European officers, but it was only in Bombay that any real attempt was made to study Indian agriculture. This was done by Mr. Mollison, the Director of Agriculture, who realised its importance from seeing the dire results of successive famines in that presidency. Elsewhere the farms attached to the agricultural colleges tended to adopt European methods of farming, rather than to study those which were indigenous to the country.

151. During this period the Royal Botanic Gardens and the Museum at Calcutta made a botanical study of many of the Indian crops, and investigated local industries and crafts connected either directly or indirectly with Indian agriculture. Such information was published in the Indian Agricultural Ledger, which had a series devoted to agricultural crops and practices.

152. It was not, however, till early in the present century, when Lord Curzon was Viceroy, that a really determined effort was made to improve Indian agriculture. An Indian Agricultural Service was established, and a nucleus staff, consisting of two agricultural officers, a botanist, a chemist, and a principal of a newly organised Agricultural College and Research Institute, was appointed to each province, while an Imperial Research Institute staffed with specialist officers was started at Pusa. The provincial staffs were subsequently increased, as need arose, by the addition of more agricultural officers and of other technical officers, such as entomologists, mycologists and, later, crop specialists. The duties of the agricultural officers were in the first place to make detailed tours in the districts, to survey existing agricultural practices and, where it was considered necessary, to initiate agricultural stations where local practices could be investigated, and to improve existing agricultural crops by selection.

153. This new outlook on tropical agriculture was a definite break from previous policy. The Indian Provincial Departments of Agriculture, as newly constituted under Lord Curzon's viceroyalty, were not directly concerned with plantation crops, except in so far as these were indigenous to the country and to peasant agriculture. Planters' Associations had their own scientific services, usually financed by an acreage cess, and Provincial Governments sometimes assisted by grants and by seconding officers of the Agricultural Service. It is interesting to note that the Ceylon Department of Agriculture, which for many years had concentrated on plantation crops, also handed over this work to research institutes in order to be free to give its own undivided attention to indigenous agriculture.

The Nigerian Department of Agriculture

154. It may be wondered what connection the preceding paragraphs have with West Africa. This lies in the appointment in 1921, as Director of Agriculture in Nigeria, of an officer with Indian experience and outlook. Up to that time attempts at improvement had been based on the introduction of new export crops, which were often ill adapted to native agricultural practice. With the reorganisation of the Department of Agriculture it was

realised that, if the people were to be adequately fed and given more purchasing power, attention must be paid to indigenous agriculture and the fund of accumulated knowledge this had created. Coming from India to Nigeria the new director must have been impressed by the fact that the land was not permanently farmed. In India the farmer depended on cattle to till his fields and to provide manure, but in Nigeria agriculture was based on shifting cultivation, in which after a few years' cropping the land was allowed to revert to bush to restore its fertility. It must also have been evident that around the headquarters of the department at Ibadan in the Yoruba country the land was being farmed without a sufficiently long period under this bush fallow.

155. *Green Manuring.* Attempts, extending over many years, were therefore made to see whether land could be kept under permanent cultivation without extraneous sources of manure by growing green manure crops and turning these into the ground. After extensive trials, a black-seeded type of Bengal bean (*Mucuna aterrima* Holl.) was found the most suitable crop for the purpose. As this is usually sown and established in some standing crop, which is harvested in the usual way, the green manure crop continues to occupy the ground when nothing else would normally be grown. The acreage under food or cash crops is not seriously reduced, and the yields per acre are considerably increased over those of ordinary native practice, but at a higher cost in labour. Perhaps it is for this reason that the Yoruba farmer has not taken up this method. It was also probably too great a jump from bush clearing and mixed cropping to growing pure stands of crops, including one which had no direct value but was merely to be turned into the ground. The Department of Agriculture realised this difficulty, and, while continuing many of its older experiments, has devised new ones to include mixtures of crops.

156. We cannot help thinking that more should be done with existing leguminous crops for the maintenance of soil fertility. The three crops, cowpeas, Lima beans and *Sphenostylis stenocarpa*, are usually interplanted among other crops which take a comparatively long period to mature. We do not know at present how far these benefit the crops among which they are grown, but there are good theoretical grounds for believing that the effect should be considerable. It is now established that leguminous plants can excrete from their nodules simple nitrogen compounds built up from atmospheric nitrogen, and that these compounds or their immediate decomposition products are available to non-leguminous plants sharing the same soil. There is even evidence that leguminous plants, and also some of the oilseed plants, can dissolve some of the less soluble phosphates in the soil and make them available to other crops incapable of attacking them directly. Such effects are well recognised in the grass lands and forage crops of Europe, but they are likely to be even more important under tropical conditions, where the opportunities of loss between one crop and a succeeding one are so much greater on account of higher temperatures and torrential rainfall. In addition there is the important fact already mentioned that most leguminous crops send their roots to great depths, beyond the range of those non-leguminous ones which depend mainly on the surface soil for their supply of nitrogen. The circumstance that inter-cropping is almost universal throughout tropical Africa is in itself strong presumptive evidence of some direct benefit. So far these questions have been but little investigated in West Africa. It is possible that the systematic study of mixed cropping and other current native practices might lead to comparatively minor modifications in Yoruba and other forms of agriculture, which might in the aggregate do more to increase crop production and soil fertility than revolutionary changes to green manuring or mixed farming.

157. Green manuring experiments were also successful at Ilorin, but not at Yandev in the Benue Province, at Umuahia in the Eastern Province, or at Kano and at Samaru in the Northern Province. At Yandev and Umuahia the green manure crops failed to maintain soil fertility; at the two northern stations the growing season was too short to allow both a food crop and a green manure crop in the same season. Other methods had therefore to be tried.

158. *Mixed Farming in Northern Nigeria.* In the neighbourhood of Kano land is kept permanently under cultivation by using the animal droppings from the town. Experiments at both Samaru and Kano showed that fertility could be maintained by periodically applying the cattle manure made by working bullocks, and that even small dressings of two tons per acre were sufficient to raise the yields of food crops. The difficulty in getting the new practice of mixed farming adopted was that the bulk of the farmers did not own cattle. The large

[PARAS. 113—5

"Lads of the village" in the densely populated Ibo country

[PARA. 120

Ideal conditions for cocoa. A complete canopy preserves the ground cover provided by the natural leaf fall of the cocoa trees. Ajia, near Ibadan, Nigeria

herds in the Northern Province are owned by nomad Fulani, who may be persuaded to sell their male stock, but who are very averse to selling female breeding stock. So far the Department of Agriculture has purchased bullocks with funds made available by the Native Administration and these have been sold to mixed farmers, but it is bound to be uphill work until the Hausa farmer is able to breed his own animals.

159. The Hausa farmer has been quick to realise the benefit to be derived from mixed farming, provided he can obtain a sufficient price for his produce to pay off the initial debt incurred in purchasing animals and implements. It must, however, be realised that the new system is a tremendous innovation, and that progress will inevitably be slow. The Hausa has little knowledge of the care and management of cattle. Particularly careful management is needed in a country in which all cattle suffer from trypanosomiasis and may break down in health and probably die if they are worked too hard.

160. Then again, the farmer must be taught to appreciate the value of bedding for his animals. He knows that cattle dung fertilizes the land, but it is difficult for him to realise, till he has had experience, that rough grass, old thatching straw and other vegetable growth used for bedding are of almost equal manurial value. Then again, the only means by which he can convey the manure from his cattle shed to the field is by head load. Manure made in the dry weather of the north is of necessity rather bulky, and to manure even an acre of land means carrying manure many miles. A few carts have been introduced, but they are expensive. Moreover, there is the danger that they will be used for general carting work on hire in the off-season and that the bullocks will be overworked and die. Sledges have been tried with a certain amount of success, and a very primitive type of cart is under trial at Maigana. In the Mamprusi area of the Gold Coast the difficulty of conveying manure to the fields has been overcome by the people themselves by dragging it on a raw hide. It is extraordinary that the wheel has never been known in tropical Africa, not even the potter's wheel. In the East the wheel is well known, and various types are used in different regions, from the solid wooden wheel, which is merely a rounded cross-section of a tree trunk, or a stone wheel of a similar shape, through all stages of the open cart-wheel to the one with spokes and felloes and an iron tyre. It surely should be possible in the forests of the south to find timber which would not alter its shape in the " harmattan," and to have the felloes, spokes and axles sent up north. If every mixed farmer had a cart there would in time be no incentive to work animals for cart-hire.

161. Much also has yet to be learnt and taught about the feeding and maintenance of animals. It is essential that they should be in prime condition for the busy season at the commencement of the rains, and it is therefore essential that the right types of fodder and concentrates should then be available. Less valuable materials should be used during the slack season, when the animals can be placed on a maintenance ration. In the very dry districts of the Deccan in India, where there may be only a single sowing rain and the farm lands may be several miles distant from the village water supply, the farmers make every effort to have their animals really fit for the strenuous few days of the sowing season, when the animals are worked from daylight to dusk. All the pulse straw, as well as the leaves of pulse crops which are shed in the field at harvest, are swept up and reserved to prepare the bullocks for this critical time, when they may also be given grain, cotton-seed or groundnut cake. Further, the working bullocks are continually under the eye of their owner, who will get up three or four times in the night to feed and water his beasts. This example from India is given in order to emphasise the important part which feeding plays in maintaining bullocks in working condition ; it is of even greater importance in Nigeria, on account of trypanosomiasis. It may mean building several stacks or bins of different types of fodder for use at different times of the agricultural year, but the trouble entailed is well worth while. Further, if bedding for the stock can be brought in from the bush, it will assist in conserving straw for fodder and at the same time add to the fertility of the farm lands.

162. When the system of mixed farming develops, there should be a market for cotton-seed or for cotton- and groundnut-cake. Sooner or later the installation of seed-crushing mills in Northern Nigeria must be considered. India is well advanced in this direction, with its indigenous oil presses and, more recently, its power presses. As the output of the Hausa farmer increases he should become able to purchase cotton-seed, which could be crushed at the ginnery to destroy its germinative power and so prevent the use of uncontrolled seed. It may even be

advisable to subsidise this use of cotton-seed in the interest of soil fertility, for it is not to be expected that the mixed farmer can intensify the output from his land without returning something to replace the plant foods sold off in his crops. Cotton lint and the oils of cotton-seed or groundnut would carry out of the country only products from the atmosphere, and would take nothing from the soil if the seed residues could be returned to the land through animals. In trying to visualise future developments it is well to bear in mind that engines of the semi-Diesel type might use cotton-seed oil or groundnut oil and thus avoid the double rail journey of oil seeds to the coast and of petrol back again.

163. The successful attempts to base a stable agriculture on mixed farming in Northern Nigeria has led the department to experiment on similar lines in the wet regions of the south. In our opinion mixed farming has much less chance of success in areas with a humid and debilitating climate, where trypanosomiasis is rife, and where the shortage of lime and phosphate in the soil militates against the raising of normal live stock. In the southern areas the department's concentration on mixed farming problems seems to have directed attention away from other approaches to the maintenance of soil fertility.

164. *Rotational Grass.* In the Benue Province agriculture has deteriorated very considerably in recent years. Fertility has receded, and on this coarse, gritty quartz soil it is difficult to check erosion. On the Agricultural Station opened at Yandev about 1927 it is noteworthy that so far no attempt has been made to work the land on contours, reliance being placed on neatly made ties between the wide ridges at intervals of a few yards. This practice was undoubtedly effective, but it is unlikely that the Munchi would achieve such fine workmanship if he were left to his own devices. Some less ambitious system of protecting the soil is needed.

165. The Munchi people have over-farmed their land, and reduced the period of resting fallow until trees have now almost disappeared and "spear grass" (*Imperata cylindrica*) has extended everywhere. "Spear grass" has become almost as great a menace as depleted fertility, since weeding, especially in yam gardens, is now too heavy a task for the women. Observations by the Agricultural Officer at Yandev have shown that this grass can be controlled by the deep-rooted perennial grass, *Andropogon gayanus* Kunth. Where it is present this grass will spread naturally during a sufficiently long bush fallow. Trials at the Agricultural Station have shown that it can be established more quickly by planting. This offers a method of soil conservation which might appeal to the people, especially the women, who have to weed the yam gardens.

166. *Special Problems of the Oil-Palm Belt.* When the Department of Agriculture opened a station at Umuahia in the heart of the oil-palm belt, it was anticipated that soil fertility might be maintained by green manures. The soil was, however, so poor that the Mucuna did not grow well, and in a few years the land was so much further impoverished that it became impossible to establish the green manure crops or to grow any food crop satisfactorily. Further trials have been made with *Tephrosia candida* DC. and pigeon pea (*Cajanus cajan* (L.) Millsp.), grown as green manure crops. Both these can be grown as perennials and, owing probably to their deeper tap roots, they proved to be superior to Mucuna, but here again the yields of crops subsequent to turning in the green manure were not satisfactory; nor is the Tephrosia altogether healthy, showing as it does symptoms of chlorosis. This lengthening of the period when the green manure crop occupies the ground is allied to the native custom of bush fallowing.

167. The department is now trying to devise more efficient methods of employing the tree *Acioa barteri*, which is already planted and coppiced by the Ibo people to produce a bush fallow in rotation with food crops. The possibilities of composting are also being examined. This practice is used in a perfunctory way by the Ibos, who put vegetable waste into pits within their compounds and grow a few vegetables with the resulting compost. We would suggest that composting offers great promise in this area, for leaves, light brushwood and weeds can be got from the bush around the communally-run clearings. The trial compost heaps we saw were unduly elaborate, and some of the agricultural officers seemed to assume that compost could only be made where animal droppings and urine were available. This is far from being the case, as any European horticulturist could testify. All that appears necessary is to ensure a reasonable balance of leafy and more resistant material, and to prevent the heap from becoming acid by adding ashes, burnt earth or limestone. From the work in progress it should soon become possible to develop simple composting methods which might be taken up by the more enterprising heads of clans.

168. The Department of Agriculture's efforts in this area must, however, have appealed to the people, who, in the initial stages, had opposed the Government's taking over the land for a station. Recently one important clan has requested the assistance of the department in solving the problem of increasing crop yields and soil fertility, and offered some of their communal land for field trials. This co-operation has been welcomed, and the preliminary experiments have indicated that lime and phosphates will give marked increases in yield. It now remains to see whether such results can be applied economically. It may be desirable to subsidise the introduction of lime and phosphatic fertilizers unless palm-oil prices increase sufficiently to bring much more money into circulation.

169. One of the main lines of work on which the Department of Agriculture has concentrated has been the formation of private oil-palm plantations. The village stands of oil palms are communally owned. They are mostly old trees, often with an undergrowth of suppressed seedling trees, which remain more or less dormant until they can by chance get their crowns exposed to the light. They are usually overcrowded and are more often than not a poor type of palm, giving only a small crop if they crop at all. The original objective of the Department of Agriculture was to improve existing groves by removing redundant trees and, where necessary, planting seedlings. This was shown to improve yields, but it entailed a good deal of care and labour, which is not always easy to arrange when the grove belongs to a community and not to an individual. This work of improving groves has not made much headway, but considerable progress has been made by starting *de novo* with plantations which are individually owned, using seedlings from selected high-yielding trees. There are numerous demonstration plots of such palms established on lands attached to the village schools and looked after by the pupils. The high yields from these plantations serve as a useful object lesson, and among an increasing number of clans a demand for seedlings has arisen, and a large number of successful private oil-palm plantations have been established. The main hindrance to the extension of this work is land hunger. No objection is raised by the elders of a clan to the planting of raffia palms, because these are short-lived, being killed by tapping for palm wine when they have reached a certain stage of maturity. The oil palm is a long-lived tree, and it has not always been possible for prospective planters to obtain the permission of their clan for what would in fact establish private ownership of the land. Communally-owned plantations are not yet practicable, as it is difficult to arrange for labour for maintenance until the palms come into production.

170. *Chemical Work on Soil Fertility Problems.* The Department of Agriculture has undertaken a number of preliminary field experiments to study the mechanism of the various methods proposed for maintaining soil fertility under permanent cultivation. Some of these experiments gave unexpected results, which, if confirmed and followed up, may resolve some of the paradoxes in West African agriculture and point the way to new developments. When green manuring was first introduced it was naturally assumed that its main benefit would come from the atmospheric nitrogen fixed by the bacteria in the nodules of the leguminous plants. Field experiments showed, however, that spreading the ashes left after burning a cut and wilted green manure crop gave just as good results on the following food crops as burying the whole of the green crop. Removing the ashes from the plots caused a marked loss of fertility. Mineral elements mobilised by the green manure crops are thus more important than the atmospheric nitrogen fixed by it. Soil analyses showed that the ashes increased the supply of exchangeable bases in the soil.

171. Again, when experiments in the Samaru and Kano station had shown that 1 or 2 tons of farmyard manure per acre gave notable crop increases, comparisons were made between farmyard manure and inorganic fertilizers. In the first trials the inorganic fertilizers were ineffective, and it therefore appeared that the farmyard manure had physical or biological effects of special importance. For a few years no further interest was taken in fertilizers or the plant nutrients supplied by farmyard manure. The original experiments had been made with a ground phosphate rock from Abeokuta. When they were repeated with imported superphosphate, diametrically opposite results were obtained. Very small dressings, containing as much phosphoric acid as the standard dressings of farmyard manures, proved equally effective in increasing the yield. This again shows that mineral elements are of particular importance in soil fertility. The early experiments doubtless failed because the northern soils were not

sufficiently acid to attack such insoluble phosphates as those from Abeokuta. There is a moral in this story. It is unwise to restrict experiments to local products until the fundamental problems have been properly studied, without any limitation dictated by the economic practicability of the experimental treatments.

172. If future work should confirm these early indications that phosphates and other ash constituents are more important than organic matter and nitrogen, it may suggest new approaches to the problem of building up soil fertility. The effects of farmyard manure need detailed analysis for the various conditions under which mixed farming is being tried. It is important not to make the mistake of ascribing to 1 or 2 tons of farmyard manure on an African mixed farm the effects associated with 10 tons or more of much richer material used under totally different conditions in Great Britain. Much of the available nitrogen must be lost by exposure to the air. The physical effects of such small dressings must be relatively small, and at high soil temperatures the organic constituents must be rapidly oxidized away. If the inorganic constituents are of greater importance than the organic ones, the need for bringing in all possible vegetable matter from outside the cultivated land will become clearer. This material may be restored to the land either through farmyard manure or composts, but under some conditions it might be better to follow the traditional practice of burning bush growth or household waste as a means of restoring ash constituents to the land.

173. The possibility of using phosphatic fertilizers in the near future should not be ignored. In assessing their value it must be remembered that they not only increase the yield but may also greatly improve the nutritional value of the crops grown. In the diet of the Ibo people the minimal requirements of calcium and phosphorus are met in part by dried fish, but additional supplies in richer foods would probably be beneficial. On the very acid Benin sands of the oil-palm belt the insoluble mineral phosphates from Abeokuta might prove effective. Limestone could be obtained from Enugu. North African phosphates might well be supplied for establishing new palm groves ; they are already imported for the European oil-palm plantations.

174. Other local sources of phosphate remain untapped. There are large accumulations of unused bones near some of the large towns, for the African generally buys meat without bones. Further supplies could be collected in the northern cattle countries, when suitable methods are developed for preparing bone meal or bone ash. In addition, the horns, hoofs and offal from slaughtered animals could furnish a small but useful supply of nitrogenous fertilizer for vegetable crops. The possibilities in these directions will increase rapidly when meat can be sent south in refrigerator vans.

175. *Botanical Work on Cotton and other Crops.* In Northern Nigeria the Botanical Section of the Department of Agriculture has endeavoured to improve the yield, disease resistance, and quality of an American cotton, "Allen's Long Staple." Since its introduction in 1912 this cotton has greatly altered its vegetative characters, becoming more hairy, and therefore more resistant to attack of jassid and other sucking insects, which carry disease.

176. The original intention behind the introduction was to produce within the Empire a staple cotton, suitable for spinning the finer counts then required for the Lancashire mills, and valuable enough to cover the heavy ginnery and transport costs and leave an attractive margin for the grower. It is well known that long-staple cottons require a relatively long growing season, preferably under more humid conditions than are usually experienced in rain-fed inland continental areas. Staple cottons are usually grown where moist conditions are maintained by proximity to the sea or by irrigation, as in Egypt, the Sudan or Sind. In Northern Nigeria intensely dry soil and atmospheric conditions set in at the critical stage of development of the cotton-seed fibre, and the result is that the staple is weak.

177. When the Department of Agriculture was reconstituted in 1921 it was faced with a dilemma, which probably was not then fully understood. There were three alternatives : to improve the already acclimatised American varieties in yield, quality and disease resistance ; to resuscitate the old-established cottons of this part of Africa, such as the low-yielding Old World indigenous cotton and the strains of *Gossypium punctatum*, which was fully established in the dry north of Africa, but which at that time was not allowed to be grown ; finally, to introduce and acclimatise other varieties of cotton better adapted to this trying climate, and ultimately to improve them by selection or hybridisation.

[PARA. 158

A " mixed farmer " in the Kano country standing beside his harvested heap of guinea corn heads

[PARA. 159

Hausa homestead adapted for " mixed farming." The newly constructed loose box for housing working cattle will in due course be roofed in. Kafin Soli, Northern Nigeria

178. The first of these alternatives was adopted, and for many years now selection work has been carried on with a view to establishing strains better adapted to local conditions. The first selections gave a cotton which was found in small trials to be a great improvement on the existing bulk cotton produced. On the strength of these preliminary results the Empire Cotton Growing Corporation decided, in collaboration with the Department of Agriculture, to open a seed farm on which selections could be grown on a scale sufficient to provide a nucleus supply of seed which, if satisfactory, might replace the mixture then being grown in the country. The first selections, which had been tested on small plots of the department, proved unsatisfactory on this seed farm, as they were much more subject to jassid attack than the mixed crop already in cultivation. Further selections were then made until, after some years of work, strains considerably more resistant to jassid were produced. Spinning tests showed that the staple of these new selections was very weak, and that there was much wastage. Further selections are now being made with a view to improving the strength of the fibre and its spinning qualities, but so far no strains have been produced which would warrant their being grown on the seed farm with a view to multiplication for seed purposes.

179. Some attempt has also been made to introduce other varieties and species of cotton from elsewhere for trial, but none of these was acclimatised to Northern Nigerian conditions and all have since been abandoned. Work on the third alternative has recently been commenced. In a few out-of-the-way places the old-established cottons of Nigeria were still found in cultivation in spite of prohibitions, and at the time of our visit these were being grown at the Agricultural Station at Kano for multiplication and preliminary selection.

180. It will be seen therefore that cotton cultivation in this region is at the cross-roads. There does not seem to be any prospect of permanent and large expansion of this industry as long as it is based on the type now grown.

181. The Empire Cotton Growing Corporation's seed farm at Dawdawa has never been able to fulfil the functions for which it was started. It has, however, provided the means for testing the selections made by the Department of Agriculture in large-scale trials both in the field and in the mill, and it has prevented the distribution of unsatisfactory seed to farmers. It has also been able to do useful work in testing various aspects of mixed farming.

182. In Northern Nigeria the Botanical Section has made a collection of varieties of the other crops in native cultivation and selected strains giving higher yields or having other valuable agricultural characters. Work has also been commenced on indigenous grazing plants with a view to incorporating pastures into the mixed farming system. In Southern Nigeria research has been carried out on the plantation crops—oil palm, cola and cocoa. In the cocoa area of the south-east corner of Nigeria alternative plantation crops have been considered. The possibilities of fruit culture for local consumption and export are being explored ; various citrus fruits and different varieties of pineapples have been grown experimentally, and suitable planting material distributed.

183. Selection work has also been carried out on other crops grown on ordinary bush farms to improve the yield and quality of Ishan cotton, to find wilt-resistant forms of cowpeas, and types of Lima beans suitable for local consumption and export.

The Gold Coast Department of Agriculture

184. The work of this department has to a great extent been subordinated to the marketing of the cocoa crop. The Government shared in the prosperity which cocoa brought to this dependency. It imposed an export tax on cocoa, and its customs revenue from imports increased enormously. The money was spent almost as quickly as it came in. Railways and all-weather roads were constructed for the rapid movement of the cocoa crop from the producing areas to inland markets, and then to the ports. An excellent harbour was constructed at Takoradi and connected with the terminus of the railway from Kumasi to Secondee. Large sums were spent on survey, education and health services, and the administrative service was greatly enlarged. Recurring expenditure rose rapidly, and, as Government income was so directly dependent on the cocoa crop, it was but natural that the Department of Agriculture should devote much time and energy to this crop.

185. It is therefore all the more extraordinary that until 1937 there was no single agricultural station in the cocoa belt proper at which research could be carried out on the requirements of the crop. It is difficult to see how any officer of the department could be expected to offer correct advice on cultural or other treatments, as he had had no opportunity to acquire knowledge under the local conditions. Thus when diseases and pests became serious, the technical officers of the department had no means of knowing how any remedial measures they might suggest would affect the general health of the trees. At one stage they suggested cutting out diseased parts of the trees, but this opened the canopy, with disastrous results.

186. Much of the work of the department has been devoted to setting up standards for marketed cocoa, and a special Produce Inspection Branch was established. Their work has not been backed up by appreciable price bonuses for better quality.

187. The agricultural officers have devoted a large part of their time to building up co-operative societies for marketing cocoa. Some of these societies also carry out the fermentation and drying of the beans. In future, the work put into the organisation of these co-operative societies, and the contacts established, should prove useful to the District Agricultural Officers when they are in a position to pass on reliable information about the cultural requirements of the cocoa crop. Now that the Government has at last opened a Cocoa Research Station at New Tafo it is to be hoped that such knowledge will be forthcoming. The station has been well equipped with laboratories and houses, but it would have been better if a site with a more regular stand of cocoa had been selected in the first instance.

188. Realising the danger of the Gold Coast becoming a one-crop country, the department has devoted some attention to alternative export crops. A successful though small industry in limes has been established in the neighbourhood of Cape Coast as a result of the work of the nearby Agricultural Station of Asuansi. There has also been a considerable expansion in coco-nut planting along the coast west of Axim ; and within the last five years a small export trade in bananas has been established, chiefly in the Western Province, with financial assistance from the Government.

189. The Department of Agriculture has been singularly unfortunate in its legacy of agricultural stations. Except in the Northern Territories, none of them appears to be typical of the country which it is intended to serve. The station at Kpeve in British Togoland is situated in a rich pocket of soil, surrounded by hills carrying scrub bush. It was originally intended for investigational work on cocoa, but as it lies outside the region of evergreen forest its value for such work is more than doubtful. At the present time such cocoa as still exists has a hard struggle to maintain itself against adverse climatic conditions. There is no difficulty in growing annual crops on this station, but it is difficult to see what assistance such work can be to the surrounding hilly country. The station at Asuansi, again, is not typical of the coastal region. It is situated on an area of land where the Ashanti hordes used to camp when they raided the coast. Judging by the large amount of broken pottery and other signs of permanent occupation, the area was an old village site, and is much more fertile than the surrounding country. The station at Kumasi is attached to Cadbury Hall, which for many years has been used for instructional purposes for the training of the African subordinate staff of the Department of Agriculture. It is of little value now owing to soil erosion and to the encroachments of the town of Kumasi on to the site.

190. It is only within the last two or three years that any attention has been paid by the agricultural staff of the department to increasing the local production of food-stuffs. Up till that time the policy of the colony (apart from the Northern Territories) had been that which for so long has ruled in the Caribbean region, namely, the production of crops for export. Recently a series of demonstration " food farms," of a size considered suitable for a family, have been opened up in various parts of the coastal region and in the cocoa belt. These farms are divided into four equal portions, so that a rotation of crops can be adopted. One portion is laid down to a temporary pasture of Centrosema (*Centrosema Plumieri* (Turp.) Benth.) and is folded with sheep, which not only enrich the area on which they graze, but supply manure for the remaining fields and some income from the meat produced. It was not possible for us to draw any conclusions, as the only farm we saw was situated on the unusually rich dark soil of an old village site. Provided the rains were sufficient its success might be taken as a foregone

conclusion. In commenting on what to us seemed an unhappy choice of centres for these experimental and demonstration farms, we more than once evoked the reply that the choice of abnormally rich soils had been made deliberately in order that the outstanding success of the crops might arouse interest. We are of the opinion—one which has been many times commented upon in different parts of tropical Africa—that the African farmer is an excellent judge of soils, and that he would naturally be inclined to discount the value of an easy success on a good rich soil.

191. The idea of utilising Centrosema as a pasture plant for sheep has been worked out at the Asuansi Agricultural Station, and it seems a pity that agricultural officers carrying out this work should not have had more knowledge, based on experimental work, on the treatment of the other crops which are being grown in rotation with these pastures.

192. Work in the Northern Territories has been much closer to native agriculture than has that of the south. Some thirty miles north of Kumasi the evergreen forest region is left behind, and deciduous open forest replaces it. This country south of the Black Volta is somewhat similar to the middle belt of Nigeria. The country is only sparsely populated, and large areas are shown on the map as being uninhabited. Tamale, the headquarters of the Northern Territories, is about 250 miles north of Kumasi by road. This road passes through sparsely inhabited country most of its distance, and without a more detailed knowledge of the country lying to the east of this road, which seems to be much more densely populated, it is not possible to assess the agricultural possibilities of the southern part of this region. North of Tamale, in the Dagomba country, one sees excellent yam cultivation and a certain amount of pennisetum millets, but it is not until the granite country of the Mamprusi Division is reached that one comes across a really dense population with a well developed and intensive subsistence agriculture. The Department of Agriculture has a large Agricultural Station near Tamale, which one infers was started at a time when there was talk of extending the railway northwards and it was necessary to ascertain the possibilities of providing adequate freight for the railway. The feasibility of growing cotton on a more extensive scale was explored, but, though the economic botanist has selected strains and has carried out trials with cottons introduced from other parts of West Africa, little material progress has been made. With the abandonment of the idea of a railway the question of other export products which could stand the cost of road transport was investigated. Trials were carried out to see whether shea butter could be extracted from the nut by modern machinery, but the costs were found to be prohibitive. The Agricultural Station at Tamale has therefore turned towards the improvement of existing methods of subsistence agriculture, while the Economic Botanist has devoted much time to selection work on native cereals.

193. The most successful work has, however, been carried out by the agricultural officer in the Mamprusi district. It is one of the few areas in West Africa where a really sound agricultural survey has been carried out as a basis for agricultural improvement. The result has been that considerable success has been achieved within a comparatively short time, and the confidence of the population has been obtained. Details of this work have been published by the department in one of its bulletins. Mixed farming is the basis of improvement; it is mainly a modification and systematisation of existing native practice.

194. Tribal life in this area is in danger of breaking up at the present time owing to the absence of room for expansion, but by more intense methods of farming the younger generation may be induced to stay at home instead of wandering off south to seek work and perhaps remaining there as labourers. It has already been possible to secure local support for prohibiting grass fires in order to conserve grass for bedding cattle. The Native Administrations are now working very keenly, and may be trusted to support other sound measures.

Sierra Leone Department of Agriculture

195. The work of the Department of Agriculture was formerly patterned on that of the Caribbean region, namely, the growing of plantation crops for export, except in the early twenties, when a subordinate officer of the Madras Department of Agriculture was engaged for rice work in the Great Scarcies. From what one can learn he was left very much to his own resources, and little interest was taken by the Director of Agriculture in his work. The result was that little was accomplished, and, on his return to India a few years later, work on rice was allowed to lapse.

196. There is a large Agricultural Station at Njala in the Protectorate, where all the technical officers of the department are stationed. Here plots of numerous plantation crops were established—cocoa, tea, various types and species of coffee, cola, agaves, rubber, oil palms obtained from different parts of Africa, as well as the Deli palm of Sumatra, various species and varieties of citrus fruits, cover crops for plantation crops, etc.

197. In 1927 a large fruit farm for growing citrus and bananas was established in the colony at Newton, and shortly afterwards the Government sanctioned the opening up of four thousand acres for oil palm at Masanki. This last work was carried out by officers of the Forestry Department. Nurseries were established in various parts of the country, where seedlings of coffee, cocoa, etc., were raised for distribution to anyone willing to plant them. With the single exception noted above, work on the crops of the country was not encouraged, in spite of the fact that there was recurring distress on account of the shortage of the rice crop.

198. In 1929 Mr. Stockdale (now Sir Frank) and one of the writers visited Sierra Leone. On their recommendation an agricultural officer was deputed to visit Ceylon and the West Coast of India to study methods of rice cultivation under conditions very similar to those in the valley swamps of Sierra Leone. Nothing was done, however, to utilise the knowledge thus acquired until there was a change in the directorship of the department. The present director, soon after his appointment, arranged for this officer to make a thorough agricultural survey of the Great Scarcies. Funds were then made available for opening a rice station at Rokupr in this region. As a result of the work carried on at this station, followed up by work in the villages, there has been a large extension in the rice area, till at the present time most of the suitable mangrove swamps have been reclaimed and brought under permanent rice cultivation. Recently an agricultural officer carried out a further survey of the potential rice areas in the Southern Province (Sessional Paper No. 7 of 1938). It would seem that the possibilities of development in this new area are likely to be as great as, if not greater than, in the Scarcies. The report points out the urgency of the matter. At the present time the people in these chiefdoms depend on hill rice grown as a rain-fed crop. The system followed is to clear an area of bush, burn the brushwood, and sow rice, often mixed with a little sorghum and grain pennisetum. The land is then planted with cassava after one or two years of rice, now usually one, and allowed to revert to bush. Owing to serious erosion, which takes place on these sloping hill soils under the heavy monsoon rainfall, fertility is easily lost, and it takes many years of bush fallow to restore it. Where population has increased the period of bush fallow has been shortened, with the result that many of these soils can now only grow a fine thatching grass, which after it is burnt allows little or no protection to the open hill side. It has become essential, therefore, that a different system of rice farming should be adopted before the country is entirely ruined, and the method developed by the people in the Scarcies indicates what can be done. A further survey has been made of the colony area by the Agricultural Officer in Charge (Sessional Paper No. 8 of 1938).

199. We feel that the rice work now being done in Sierra Leone is of definite value. It has not only cheapened the cost of rice to the non-agricultural population, but it has removed that dread of scarcity, which was previously a recurring menace. It has also added to the wealth of the country, as Sierra Leone is now in a position to seek other markets for the sale of its surplus production.

The Gambia Department of Agriculture

200. After 1918, when the Gambia was prosperous from the sale of its groundnuts at very enhanced prices, the Colony created a Department of Agriculture. It had not the money to recruit men with the same standard of training as other West African departments, and for many years its staff consisted of men with a horticultural rather than an agricultural training. Fortunately one or two had a background of practical agriculture. The first director had been in charge of a botanic station in the West Indies for many years, and, though an excellent horticulturist, had had no experience of arable agriculture in the tropics.

201. Since the Gambia is entirely dependent on the cultivation of annual crops, the department started with a severe handicap. Much of the early work was devoted to produce inspection of the groundnut crop and the storage of good quality groundnuts for seed purposes. Later on, varieties of groundnuts were introduced from other countries for trial at the Agricultural

[PARA. 160

Bullocks harnessed to a cart at the Government Farm, Maigana, near Zaria, Northern Nigeria

[PARA. 239

Native well, Katsina–Daura road, Northern Nigeria

Station at Wuli in the north of the Colony. Little or no attention was paid to the other food crops grown in rotation with groundnuts, in spite of the fact that large quantities of rice were imported annually, to feed the people, who, in their anxiety to make money out of the high price of groundnuts, had reduced their acreage of food-stuffs to a dangerously low level. In 1929 an officer of the department was deputed to Southern India to study methods of arable farming in districts where groundnuts were the chief money crop, and also to investigate simple methods of lifting water, which might be used for irrigation from the Gambia River during the dry season for vegetable crops and possibly rice. On a change in the directorship of the department a new agricultural station was opened on the south bank near MacCarthy Island, where both lift irrigation and arable farming with the aid of draft cattle could be tried out on a practical scale. Useful work in both these directions has since been accomplished, and attention has been paid to cereal crops which can be grown in rotation or mixed with groundnuts.

202. Considerable impetus has been given to arable farming by the work done by the Veterinary Officer in immunising cattle against rinderpest, and as a result the cattle population is now on the increase. On the light sandy soils of the Gambia there is no very great scope for increasing crop production without the assistance of animal manures, and this must in its turn depend on an increase in the live-stock population. The people are aware of the value of cattle manure, and pen any available cattle on land which is to be cropped.

203. The principal method by which food-stuffs can be increased, however, is by the utilisation of the extensive inland swamps for the cultivation of rice. This will not be an easy matter, as in the Gambia rice is regarded as a woman's crop: women do all the work of production and harvesting, and the crop is stored separately as the woman's property. Women of this class are always much more conservative than men, and it may be some time before any large increase in the production of rice can be achieved.

204. Recently a change has been made in the recruitment of officers for the Gambia Department of Agriculture. Instead of direct recruitment officers are seconded for a period of years from the Nigerian Department of Agriculture. Theoretically this scheme may sound satisfactory. The disadvantages are that officers are not eager to be seconded, and that by the time they become familiar with local conditions they revert to their former posts in Nigeria. More important than either of these considerations, however, is the personal factor in dealing with African peoples. It is essential that officers carrying out extension work should have the confidence of the people among whom they work, and constant changes in personnel are not conducive to this.

Budgets of the Departments of Agriculture

205. It is difficult to compare the proportional expenditure of the different West African Dependencies on their agricultural services, but it is evident that the smaller colonies spend relatively more of their revenue on agriculture than the larger ones. In Nigeria the expenditure has remained more or less stationary at about 2 per cent of the revenue, except when it fell during the period of acute depression. This excludes the Produce Inspection Service, which in this colony is more than self-supporting. But the amount available for working expenses has continued to shrink as, with increase in staff and seniority, the proportion of the vote which is required to meet personal emoluments continues to expand at the expense of amounts sanctioned for carrying on the work of the department. If it were not for financial assistance provided by Native Administrations, it is doubtful whether the department could carry on a useful existence.

206. In the Gold Coast the net expenditure on the Department of Agriculture is considerably higher, and is now over 3 per cent of the total revenue. This includes, however, the cost of produce inspection, which apparently is a charge on Government, as the revenue in 1936-37 under this head amounted to less than £32.

207. In Sierra Leone expenditure on the Department of Agriculture has fluctuated considerably, and in 1929 reached over 6 per cent of the total revenue for the year. At that time, however, there were some rather grandiose schemes to be financed—the oil-palm plantations at Masanki, the proposed agricultural college at Njala, and the fruit farm at Newton. Then came a period when the department was apparently out of favour and the expenditure sunk to below 2 per cent of the revenue. Presumably on account of the useful work now being done in the rice areas, the proportion of the agricultural vote to total revenue is again on the increase.

208. It is a matter for surprise that in West Africa, where Government revenues are so dependent on the purchasing power of the African populations, such a small proportion of the total revenue should be spent on agriculture, which is the main source of native income. It is no wonder, therefore, that the departments tend to aim at quick results, rather than to spend money on ensuring sound foundations for a better agriculture. One presumes that this is the case with all departments which are not directly concerned with the administration of the country. One result is a tendency for each department to work on its own, instead of trying to obtain help and knowledge from other departments.

209. It is suggested that much more time should be spent on preliminary investigations before carrying out a programme of agricultural experimentation. Wherever this has been done considerable progress has been achieved. The few examples include the Mamprusi district of the Northern Territories of the Gold Coast and the Great Scarcies area of Sierra Leone. But we would go further than this and suggest that such surveys should have a wider basis, to be made with closer co-operation with other technical departments. These would include the Forestry Department, the Geological Survey, and, as regards erosion problems, the Public Works Department, as well as the Administrative Service, which has a wide knowledge of the customs and prejudices of the various peoples. This question of co-operation has, however, been dealt with in more detail elsewhere in this Report.

CHAPTER VII

AGRICULTURAL PROBLEMS IN OTHER DEPARTMENTS

Administrative Services

210. The last twelve years or so have seen a most satisfactory improvement in the contacts between the Administrative and the Agricultural Services in Nigeria. This has been due at least in part to the changed method of recruitment and post-graduate training. The Colonial Agricultural Service is now recruited almost entirely from men selected by a Colonial Office Committee to hold Colonial Agricultural Scholarships. These provide one year's post-graduate training at Cambridge, followed by one year at the Imperial College of Tropical Agriculture in Trinidad. Officers of the Administrative and Agricultural Services thus share in residence a part of their post-graduate training, and there is no longer that regrettable gap which existed when men appointed as agricultural officers were often merely horticultural students with no knowledge or experience of arable farming.

211. In recent years successful attempts have been made at Samaru to improve the contacts by annual conferences between administrative and agricultural officers. It was noticeable to us that the co-operation was particularly close and effective in those areas where the two classes of officers were working together through Native Administrations, especially in Northern Nigeria, the Eastern Province of Southern Nigeria, and the Northern Territories of the Gold Coast.

212. In the course of his duties, magisterial or otherwise, the administrative officer must obtain a close insight into native customs, such as the system of holding land either communally or by individuals, the admission of strangers for cultivation, the question of men's crops and women's crops, and the separate ownership of live stock within the same household. All these customs are extremely complicated, and vary in important details from place to place. We have already referred to the admirable study of North Mamprusi agriculture by an agricultural officer. A valuable series of studies on systems of land tenure have also been made by administrative officers, notably one by Ward Price on those of the Yorubas. Such work is of the utmost importance, for it is difficult for the European to appreciate the distinction that the African generally draws between the land and its produce. Speaking very roughly it seems that the occupier of land claims the crops which he has planted, whether annual or perennial, rather than the land on which they are grown. If a woman plants certain crops on the land held by the man and his family, she may have an absolute right to the produce, and the same applies to the crops which the man plants and cultivates. Such property in crops is a serious difficulty; for example, in attempts to improve oil-palm lands by removing unproductive trees. The old systems are inevitably disturbed when new permanent crops are planted or the pressure of

population increases, or the productivity of the land falls. In some parts it will become essential to introduce restrictions on methods of land utilisation. Thus it may be necessary to prevent excessively frequent cropping with groundnuts on the sandy soils in the extreme north of Nigeria, to control the firing of bush, either completely or by restricting it to an early burn ; and in some areas, where gully erosion is serious, to prevent cultivation altogether. All such interference with native custom must be thoroughly worked out and tactfully introduced by agricultural officers and administrative officers working, wherever possible, through the local native authorities.

213. One would also be inclined to include forestry officers in such co-operation, but the impression we gained was that at present this would be inadvisable, because the various restrictions already imposed on the use of tree products and by the reservation of forests have created a feeling of distrust, which may take years to overcome.

FORESTRY DEPARTMENTS

214. In many parts of West Africa, problems of land management are the concern of both the Departments of Agriculture and Forestry. In the preceding chapter it was found convenient to preface the story of the growth of the Departments of Agriculture by showing how they grew out of experience in India. In order to see the borderline problems between agriculture and forestry in proper perspective it is particularly necessary to consider the development of the Forestry Departments from Indian experience in order to bring out certain fundamental contrasts between the conditions and requirements of Indian and West African farmers.

215. The pioneers of forestry in the tropics consisted of the band of German forestry specialists employed by the Government of India to found a Forest Service in British India. Their names are familiar to every forest officer—Sir Dietrich Brandis, Schlich, Fischer, Ribbentrop, and many others. It is to these officers and the subsequent generations of forest officers trained by them and their successors that the development of the Forestry Departments in the British Colonial Empire is due.

216. Now the forest policy developed for the needs of the Indian Empire is not necessarily that which is best suited to the needs of British West Africa, or indeed to other parts of the Colonial Empire.

217. It may be said that the main purpose of a Forestry Department is to cater for the needs of the people of the country—i.e. to supply agricultural and domestic requirements. It would be as well, therefore, to give a brief description of Indian conditions and the manner in which the needs of the people have been met. One has heard a good deal about the system of mixed farming which is being introduced by the Departments of Agriculture in West Africa. Such a system of farming is universal throughout India, except among a few jungle tribes who still exist in forest tracts by shifting cultivation. One may say, therefore, that practically the whole of the cropped area of India is permanently cultivated by means of implements drawn by working bullocks. The number of working cattle in British India alone must number in the region of fifty millions. In order to maintain this stock of draught animals very extensive breeding and rearing of cattle is necessary. Dairy buffaloes are also kept for the supply of ghee, and flocks of sheep and goats are maintained to assist in manuring the fields and for their meat and skins. A large proportion of these various types of live stock depend on grazing. Though most villages have common grazing lands, these are little better than exercise grounds, since they are invariably overstocked. Moreover, when the whole countryside is under crop, cattle have often to be taken to a distance for grazing, until they can return to the villages after the crops have been harvested, when straw is available for feeding stock as well as a certain amount of grazing in the newly harvested fields.

218. Again, since all the cultivated land in India is worked with implements drawn by cattle, and as these implements are mainly made of wood, and as all produce is carted from the village to the markets in country bullock carts, immense quantities of suitable timber are required for making ploughs, cultivators, seed drills, bullock hoes, carts, etc. Then again, wood fuel is needed for the dense agricultural population and the towns. Other requirements are timber for house building, cut grass for feeding live stock, and green leaves for manuring rice fields. To meet these enormous requirements as fully as possible the natural resources of the country have had to be conserved.

219. The land of British India is divided into two main classes—cultivated, including land fit for cultivation, and uncultivable. The latter class includes areas too steep for cultivation and too rocky for working implements. This naturally divides the country on the one hand into large expanses of cultivated land where tree cover does not exist, except in compounds and along field boundaries, and on the other, large expanses of land which are unfit for cultivation and which are covered with forest or tree scrub. In the areas remote from cultivation these may consist of high forest, but as the cultivated areas are approached the type of forest becomes more degraded. It is in these latter areas that the bulk of the reserve forests have been formed, since it is necessary to conserve their resources to meet the needs of the adjoining farm lands. Grazing permits are issued for live stock at a nominal charge, and thus the stock allowed in the reserves can be restricted to safe numbers. Similarly, permits are issued for cutting grass, collecting green-stuff for manuring rice fields, collecting firewood and other materials. It will be clear, therefore, that much of the work of the Forest Service is devoted to policing the reserves and preventing abuses. It is evident also that since the reserves are mainly situated on uncultivable areas, the forest officer only comes into contact with the agricultural community when the latter wants something from the forest reserves. Since the Forest Service came into existence some forty years before the Agriculture Service, its ways were set, and there has never been any close co-operation between the two services.

220. With this tradition behind the training of present-day forest officers, the Colonial Forestry Services tend to confine their activities to the reserve forests.

221. Conditions in West Africa are, however, very different from those in India. There is little or no permanent cultivation, and practically no live stock are kept on the farms. There are no ploughs and carts, and almost the only agricultural implement is the hoe. There is thus no demand for timber for carts and implements, or for fodder or grazing in the forest reserves. The West African farmer's demands for forest products are small, and limited to small timber for house building and fuel, though much of the latter can be obtained from unreserved bush fallow. In most areas some three-quarters of his holding is in bush fallow, recuperating from the effects of previous clearing and cultivation. In a sense he has his own small area of reserve forest, and he is dependent on its successful recuperation for his existence.

222. Elsewhere we have suggested that the restoration of fertility is effected by the roots of the coppiced tree growth bringing up from below plant food, which is restored to the surface soil by leaf fall and natural decay. These questions have not, however, been investigated, and no technical service has so far attempted any research work to ascertain whether it is not possible to improve tree growth under such conditions. It seems to us the Forestry and Agricultural Services should co-operate closely in initiating this research. We have nothing against the efforts which are being made by the Department of Agriculture to establish mixed farming in areas where cattle can exist. Indeed this seems to be the best solution to meet the problem of increasing pressure on the land in such areas, but in areas where cattle can only exist precariously the introduction of mixed farming methods seems to us to be Utopian. Agriculture in such areas must in our opinion be dependent on the maintenance of tree growth.

223. We have elsewhere in this Report drawn attention to the actual planting of trees of the species *Acioa barteri* by the Ibo people on areas which have been denuded of tree growth by too frequent clearing. If these people are able to effect improvement, it should surely be possible for the technical services to do so, both here and in other areas.

224. It may also be possible to devise better methods of utilising tree growth than the present ones. Wholesale coppicing and burning appears to waste organic material which could probably be incorporated with advantage with the surface soil, at least in the wetter regions. This would involve a system of composting young tree growth and applying the compost so produced as manure. If this could be done, a system of permanent farming might be established on a portion of the holding, while the tree growth on the remainder would furnish the plant food required to maintain fertility.

225. There is an example of such a system in the South Canara district of Western India. The cultivated lands consist of the valley bottoms converted into rice fields, and, according to their elevation and the water supply, they may grow one, two or three crops of rice a year. There is an established custom that the owner of the rice lands in the valley bottom has the sole

right of cutting tree leaves from the hillside adjoining his land right up to the watershed. During the wet season the women of the house collect daily so many head-loads of green twigs, chiefly of the species *Xylia dolabriformis*. These are carried down to the homestead and spread out on the floor of a sunken loose box. Here scrub cattle are housed at night. Every few weeks the shed is emptied and the raw compost thus made is stacked till it is required for manuring the rice fields. Many of these hill sides are excellently worked. They have become small reserved forests privately owned, and their incremental growth is jealously guarded to provide for the needs of the future. Is not something of the same sort possible in West Africa ? Is it feasible to do this composting without the aid of cattle ?

226. The importance of such work cannot be over-emphasised. Populations are increasing under settled government, and on all sides we hear reports of the deterioration of the natural tree cover of the countryside. The Sierra Leone Government, for example, is now developing a new wetland rice area in the coastal mangrove swamps of the south coast. This is mainly for the benefit of the chiefdoms which lie behind the area, where the tree cover has already been largely destroyed by too frequent clearing of the easily eroded hill slopes for the cultivation of hill rice. Is it not possible that the life of these hillsides could have been greatly extended if different methods of managing the tree cover had been evolved ?

227. In considering the possibility of laying out farms in such a way as to maintain the period under bush fallow, we would direct attention to trials in Tanganyika in which it is planned to keep about half of the farm under bush, small fields being opened up afresh each year and others allowed to go out of cultivation. There is room for careful studies on the coppicing powers of different African species of bush trees, as well as on the method of coppicing to be adopted. There is room, too, for more work on other methods of raising suitable trees for planting. The nursery work which we had the opportunity of seeing in West Africa was disappointing, in that most of the species grown were exotic, and practically all of these develop a shallow root system which renders them entirely unsuitable for renovating bush fallows, as their roots would be in direct competition with crop plants both for food and water.

228. Experiments should be undertaken in the extreme north of Nigeria to test various species, exotic as well as indigenous, as hedge plants. Hardly any of those which the people now grow are really efficient. Such experiments should examine methods of propagation and establishment. It has already been suggested in this Report that efficient field boundary hedges would do much to check wind and sheet erosion. Any species tested should be capable of making a stock-proof fence, since hedges are also needed to check trespass by stray live stock. It is becoming common in Northern Nigeria, especially where land is permanently cropped, to protect the fields with an earthen wall. This in itself is poor protection against trespass, and species are required which can be grown on the tops of these walls. Possibly species of *Commiphora* are worth trying.

229. The only tree introduction we saw which was of value to the farmer was *Gliricidea sepium* (Jacq.) Steud., which furnishes yam sticks in quantity, but even this species has to be grown with caution owing to its shallow root system.

230. We had little opportunity for examining the work of the Forestry Departments within their reserves, or on the means of testing timbers for different purposes in the export market. In stressing other work needed we do not wish to minimise the importance of reserves. Many of these are essential for controlling the local climate, the flow of streams and rivers, and for checking erosion. They are particularly needed in the cocoa belt and in the vicinity of mines, which are rapidly using up big areas of forest. Others are needed to conserve and exploit the timber reserves of the country, both for export and for home consumption. Possibly, in the future, reserves will be needed to provide grazing for live stock. But reserves are not the only aim of the Forest Services, and a better and more sympathetic understanding of the needs of the people might serve to show the latter that the Forestry Departments are working for their interests and not against them.

Medical and Sanitary Departments

231. The sanitary measures encouraged by the Medical Departments may well be urgently needed in some of the larger towns, but it is doubtful whether the department is wise in pressing the adoption of similar methods in places with a low density of population. Many of

the methods recommended are the outcome of those adopted in European countries for the disposal of night soil. They are necessarily wasteful of valuable plant-food material under all conditions. In Europe such waste has been excused on the grounds that the surplus food-stuffs of the world, and fertilizers, are available to meet the requirements of our people and our land. In tropical Africa, however, the people have nothing beyond their local resources to make good the inevitable losses by export and wastage from soils of low intrinsic fertility. Certainly attempts to introduce the sanitary measures enforced in parts of the Gold Coast would have serious results if they were to be introduced among the Ibo people, where the fertility of the compounds must of necessity depend on the natural habits of the people. In the Northern Territories of the Gold Coast we heard that one native chief was so filled with admiration at the construction of a septic tank, which the Medical Department had induced him to make in his village, that he proposed to live in it. Among the coco-nut plantations along the sandy coastal fringe of Dahomey and Togoland the palms around every native hut stood out as having almost twice the size and depth of green of the rest of the area. In Africa, and more especially in the high rainfall areas, crops respond phenomenally to " the sound of the human voice."

232. There is room for active co-operation between the Medical Department and the Department of Agriculture in the development of methods which will combine sanitation with the agricultural use of all wastes. Much has been heard in recent years of the methods by which the " farmers of forty centuries " in China and Japan have maintained the fertility of the soils within reach of the larger towns and villages. Fæces and urine are systematically collected and transported back to the land by methods which undoubtedly offend western ideas of sanitation, but which none the less are dictated by the overwhelming necessity of keeping up the fertility of the land in districts of high population density. It is one of the principal tasks of the Departments of Agriculture throughout Africa to teach the people methods for using all wastes to feed the land, and it is unfortunate that at the beginning of this task the Medical Department should find it necessary to try to check the most obvious way of doing this.

233. Some medical authorities have expressed concern about the danger from flies breeding in the manure of the loose boxes of the new mixed farms of Northern Nigeria. Our own observations and experience suggest that there is very little chance of flies breeding in consolidated manure beneath the feet of the animals. By contrast, we were pestered with flies from the stable manure which accumulates at the back of nearly every European bungalow in Northern Nigeria, and it appears that nothing has been done to control this menace. There is abundant experience in India, and elsewhere in Africa, that manure heaps and compost heaps can be maintained sufficiently compact or hot to prevent flies from finding breeding places, and there is promising evidence that compost heaps can be used to conserve night soil. There is room in the neighbourhood of towns in West Africa for the development of methods of combining the sanitary disposal of night soil with the production of a useful manure.

234. Much attention has rightly been given in recent years to the problems of human nutrition in the Colonial Empire, but comparatively few investigations have been made on this subject in West Africa. A useful beginning was made by Dr. McCulloch at Katsina and by Dr. Clark at Accra and Kumasi, and previously in Southern Nigeria. Here it will be sufficient to refer to some of the directions in which " the marriage of health and agriculture " calls for co-operation and joint research between the Medical, Agricultural and Educational Departments. The last mentioned, in their boarding schools, should have some knowledge of the staple West African foods in various parts, and could easily arrange to extend its knowledge. The prison authorities also should have accumulated useful knowledge. The Departments of Agriculture could furnish information about the chemical composition of the normal food-stuffs of different parts of the country. They have already compiled data for the principal fodders by the conventional methods of feeding-stuff analysis, though so far they have been unable to add many data for the important mineral constituents. It is likely that interesting results would emerge from detailed studies on the various green-stuffs used in soups. A full survey of the nutritional value of individual food-stuffs and different types of diet, such as was undertaken by McCarisson in his famous studies of typical Indian diets, is also needed. Special problems arise through the migration of labourers to the mines. We have been informed that Northern Territory labourers employed in the Tarkwa mines in the Gold Coast preferred local food-stuffs to yams, which on one occasion were specially imported for them. These labourers come from the dry cereal belt, and the yam is as strange to them as the local products around the gold mines.

235. Dr. Clark raised another general question which calls for examination. He had evidence to suggest that the Colocasias, Alocasias and Xanthosomas contain poisonous alkaloids, which contributed to ill-health when they were used as the main source of nutriment, unless they were properly cooked. He also thought that a cassava diet could induce slow prussic acid poisoning. Considerable quantities of cassava are now being grown in the neighbourhood of the large towns, where a large proportion of the population is poor and compelled to use a restricted range of food-stuffs, including much cassava.

Educational Departments

236. The form of the collaboration between the Agricultural and Educational Departments raises vexed questions of general educational policy. Few would dispute the need for a rural atmosphere in the primary village schools, and for an education which will arouse interest in the farm and countryside, as well as giving some rudimentary training in the farming crafts. This cannot, however, be secured merely by attaching a few garden plots to a school in which the teacher has had a purely urban education, calculated mainly to produce clerks. It has often been noticed that the rural native of Africa has an intimate knowledge of the plants of the countryside and their uses. His knowledge in this respect will generally be far greater than that of a teacher brought up in urban surroundings. Hitherto, the Departments of Agriculture have been chary of being associated with this type of agricultural education, though they have made their own educational arrangements by running agricultural schools to train candidates for their own staffs, and in Northern Nigeria by starting schools for youths to be trained as mixed farmers. The Achimota College has, of course, done admirable work in agricultural education, and we would have wished that it could have increased facilities for extending its experimental work, both on the grounds of its intrinsic value and to teach its agricultural students from the start the necessity for the experimental and investigational approach. Such an attitude is far more valuable than any amount of mere book-learning and certification.

237. The problem of devising a system of education appropriate to rural life is in no way peculiar to West Africa, and we have had in Great Britain, India, and many other countries some dreadful examples of the dangers to be avoided. We have, however, some very positive results. For nearly half a century now agricultural education has made steady progress in Great Britain, but it should be noted that it began with the farmers themselves. Only when they appreciated that the educators had in fact something to give did they commence to send their sons to the agricultural colleges and universities, which up to that date had been mainly for training officials. As the demand grew a large number of farm institutes with one-year courses was set up, and then the movement spread to the schoolboys, partly by means of the very successful Young Farmers' Clubs and partly by the development of agricultural sides in some of the leading public and secondary schools. The agricultural bias in the rural elementary schools came last, not because it was the least important but because it was perhaps the most difficult form to undertake. For many years now an annual conference of elementary rural school teachers has been held at Cambridge, and many of the schools concerned have undertaken serious experimental work in association with some of the research institutes. It may also be noted that broadcasting has been fully utilised, and that the talks have been given not by professional teachers but by prominent research workers in agriculture. It has also been the experience of many in the United States of America and in India that in the first instance agricultural education should consist of demonstrations to farmers, rather than attempts to include agricultural instruction in the schools.

238. In so far as analogies are justifiable it would seem that the most urgent requirement in West Africa is to concentrate on agricultural education of farmers and the training of men who can become teachers after they have served sufficiently long in the Departments of Agriculture to have acquired sound experience and the investigational approach. Perhaps, too, lessons may be learnt from the success of the Danish Folk High Schools, which provided short residential courses for adults at seasons when they can be spared from the farm work. Once the funds and trained staff are available something of this sort could be built round the demonstration areas controlled by the Departments of Agriculture.

GEOLOGICAL SURVEYS

239. Valuable as the returns from mines may be, there can be no doubt that in the long run the most important minerals in West Africa are water and those superficial deposits from which soils are formed. In the drier northern areas of Nigeria and the Gold Coast excellent progress has been made in recent years in sinking wells and building water reservoirs. In Northern Nigeria the new wells are causing a redistribution of the people, for it is easier now to move to a sure water supply than to recondition some of the old wells, which were dug by slaves before the British occupation. In these dry areas the pace and the direction of agricultural development can be controlled by the provision of water. A sufficiently rapid development of wells would go far to reduce a dangerous local concentration of farming. Now that the technique has been developed successfully the pace is limited mainly by the provision of labour and trained supervisors, and it may prove a poor form of economy to cut down expenditure on this highly productive side of the work of the Geological Surveys. The scientific staff of the survey might be released from the constructional and administrative sides, and so be free to examine the possibility of increasing the surface and underground storage of water in reservoirs and the control of flood waters and soil erosion. It is a striking fact that some centuries ago there was a civilisation around Tamale which stored its water underground in reservoirs excavated between the shales and a roof provided by the ironstone sheet. One or two of these have been cleaned out and brought into service at the Veterinary Station at Pong Tamale.

240. Brymore Jones, of the Nigerian Geological Survey, has already made a very useful study of the relatively recent geological history of the country along the Anglo-French boundary, and has shown how vital it is in determining policies of development in such difficult areas to be sure of the geological facts. There is a vast opportunity in West Africa for work on the more geomorphological aspects of geology.

241. So far the pressure of urgent practical problems on both sides, and perhaps a little of the evils of departmentalism, have prevented much active co-operation between the Geological Surveys and the Departments of Agriculture. Reference has already been made to the association of the pagan tribe settlements with soils of definite geological origin, and Trapnell has drawn attention to a somewhat similar state of affairs in Northern Rhodesia. It seems most important that there should be close co-operation between the two departments when the Department of Agriculture contemplates developments in any new area. The Geological Survey and the soil chemists must, of course, work closely together in extending the soil surveys.

242. It happens, both in Nigeria and the Gold Coast, that the headquarters of the two departments are separated by many hundreds of miles, and in consequence there is little opportunity for those informal day-to-day contacts between interested workers which mitigate the evils of a formal organisation. Here again the need for comprehensive survey work calls for some modification of existing machinery by which really efficient co-operation can be secured.

PUBLIC WORKS DEPARTMENTS

243. As has been pointed out in paragraph 53, we found that the Public Works Department of Nigeria was keenly alive to the dangers of soil erosion, and had taken careful precautions along its roads to lead the water away, so as to minimise gullying. It was also alive to the broader aspects of the problem, especially in the north where the new all-weather roads have necessarily been built along the crests of the very slight and inconspicuous watersheds. In Northern Nigeria, as in England, a new arterial road brings about a " ribbon " development of clearings for cultivation. This constitutes a serious threat to the country, because the new land opened up will be more liable to denudation and erosion than that lower down the slopes. To the Public Works Department one long-term remedy would be to push on with the new roads rapidly enough to spread the development by an immigrant population over such a wide area as would prevent continued occupation and allow much of the land to revert to protective bush. In some parts it would seem necessary to control development, either by restrictions or by requiring adequate protective measures. The course to be taken calls for co-ordination between the Public Works, Forestry, Agricultural and Administrative Services.

[PARA. 239

New Geological Survey well, Daura, Northern Nigeria. The mouth of the well is protected from pollution

244. In their work on the construction and maintenance of roads, the engineers of the Public Works Departments have acquired a considerable knowledge of the general nature of the soils, and especially of their erodability in different areas. Properly co-ordinated, this knowledge should prove useful to other departments concerned with the preservation of the natural assets of the country. The scientific survey which we discuss elsewhere would be an excellent means of effecting this co-ordination.

245. As far as our knowledge goes, there has been no systematic examination of the possibilities of irrigation works in Nigeria or the Gold Coast. It appears that there are few places along the main rivers which offer conditions appropriate for large-scale works, such as those of the inland delta of the Niger below Bamako in the French Sudan, or down the Nile valley. There may, however, be opportunity for minor irrigation works as the population increases, and as the Department of Agriculture extends its work into the north-east of Nigeria. Some developments are contemplated in the Sokoto Marshes, but we understand that the Public Works Department has not yet had the staff and funds to undertake the necessary surveys and levels.

246. It has already been suggested in this Report that some of the "fadamas" of Northern Nigeria might prove suitable for irrigation. Useful experience is being gained around Tamale in the Gold Coast in the construction of reservoirs, along the lines of the innumerable tanks of India, and it seems possible that, when the immediate need for water supplies for man and stock has been met in this way, there may be developments leading to local irrigation schemes for growing vegetables and other food-stuffs. Experimental work on these lines might well be commenced, and experience in India examined.

247. In the Gambia, rice cultivation should be expanded in the extensive swamps in order to increase the production of food-stuffs and relieve the pressure on the dry land. Here and in Sierra Leone examination by a competent irrigation engineer, working in close co-operation with the Department of Agriculture, might lead to some method of flood control which would prevent deep flooding and conserve water for irrigation.

CHAPTER VIII

SCIENTIFIC RESEARCH AND SURVEY

Organisation

248. At several points in the preceding chapters we have referred to a number of questions which in our opinion merit more serious investigation than they have received. Many of these are long-range questions of a scientific nature. In raising them we wish it to be clearly understood that we are not directing criticism at the present staffs, many of whom share our estimate of the importance of making a more thorough scientific study of fundamental questions than has hitherto been attempted. It must, of course, be realised that all technical work in West Africa is a comparatively new growth, and that the problems were not such as could properly be formulated until much preliminary explorative work on an extensive scale had been undertaken. Old publications show that at one time there was a tendency to think of the scientific workers as recluses who amused themselves by undertaking, in laboratories, work which could equally well be done in a university at home. Our own view of the situation swings to the other side. We believe that the scientific workers in West Africa have been so anxious to be of service to their colleagues who were up against immediate practical problems that they have been compelled to devote themselves, somewhat too narrowly, to questions likely to give quick returns. Such an attitude is inevitable in the early stages of development, when budget provision of funds is based upon tangible progress in production and in indirect revenue, but we are convinced that the time has come when, at the first opportunity for expansion, the whole basis of the scientific work should be reviewed. The outstanding requirements are more thorough investigation of the agricultural practices of the African in relation to the environment, and more active collaboration between specialists in different branches of science and in different departments of the Government Service. We have insufficient knowledge of the machinery and policy of the governments to attempt any detailed programme of reorganisation, but we wish to direct attention to some features which merit consideration by the responsible authorities.

Although the details vary inevitably from country to country with geographical, historical and administrative conditions, the general problems of organising research on agricultural questions have been attacked in most of them. In Great Britain the Agricultural Research Council is a recent growth modelled on the Medical Research Council and the Department of Scientific and Industrial Research, but linked very closely with the Development Commission, the Ministry of Agriculture, and the Scottish Department of Agriculture. Each of the dominions has a similar body covering both agriculture and industry, and India, too, has its Imperial Agricultural Research Council, working both through its own institutes and through the Provincial Departments of Agriculture and the universities. The colonies with important plantation industries have their own associations and research stations for individual crops (three in Ceylon, one in Malaya, and two in East Africa). Although administrative and advisory work is undertaken by these stations, the prime object is research on all aspects of the industry. In the Sudan there is a strong Agricultural Research Service, centred on the Gezira Scheme but rapidly extending its field of work to cover the whole country. Its administrative relationship to the Department of Agriculture has been modified repeatedly and experimentally during the last fifteen years, but it still functions essentially as a unit apart from the more purely administrative and educational side of the Departments of Agriculture. For the rest of the Colonial Agricultural Service the Lovat Commission proposed that a chain of Agricultural Research Stations should be set up apart from the Departments of Agriculture. The Imperial College of Tropical Agriculture in Trinidad and the Amani Research Institute in East Africa formed two of these, but the third one proposed for West Africa has not materialised. Instead, it has been proposed at the recent West African Agricultural Conference that research farms for oil palm, cocoa and rice should be set up in Nigeria, the Gold Coast and Sierra Leone respectively, and used to serve the needs of all three colonies. The oil-palm station in Nigeria has not yet been founded, but a site has been reserved and specialist members of the Department of Agriculture are assembling material and obtaining experience. New Tafo, in the Gold Coast, is also to become the headquarters for general agricultural research work, as well as for special cocoa investigations. The rice station at Rokupr has made a very promising start, though it is of necessity isolated from the headquarters of both the Department and the Government. These stations were all vitally necessary, and may be expected to do good work both on the practical development of the crop for which they are primarily responsible and on associated scientific problems, but we are not satisfied that this is enough. There still remains a large field of general scientific work calling for specialists and for co-operation with other departments.

249. We suggest that there is room for a team of specialists working under a scientific director, in either a separate department or under a council representing the various branches of the Governments concerned. This body should be charged primarily with the scientific study and survey of all aspects of West African agriculture and industry. We should hope that it would be possible for a single body to cover all four British colonies. It might even be possible for it to be extended ultimately to cover the French colonies as well. It is clearly impossible for each of the colonies to avail itself of all the necessary specialists required, and there are several precedents for joint action on highly technical questions. The three Chief Justices already form a peripatetic Court of Appeal. All colonies and dominions are associated in a collective responsibility for the Imperial Agricultural Bureaux, an important landmark in imperial inter-relationships. In several African colonies, including Nigeria, the Experimental Stations and Farms of the Empire Cotton Growing Corporation have demonstrated the success of a scheme by which specialists responsible to a central body can work in association with Departments of Agriculture to their mutual advantage. It must be admitted that this example is not quite analogous, and that the Empire Cotton Growing Corporation accepts financial responsibility for the work ; but almost every scheme for future development in West Africa presupposes that additional funds will be forthcoming from the home government.

Ecological Surveys

250. It is no part of our proposals to reduce the experimental work of the individual departments, but rather to provide a team of specialists, some of whom must be peripatetic, to work with them on the more technical and long-range questions, and to co-ordinate more efficiently than has hitherto been possible the fund of local knowledge slowly acquired by agricultural and other officers. It is difficult at present to estimate the loss which occurs through

failure to record, co-ordinate and develop the knowledge and suggestions of officers who may be transferred or retire through age-limits or ill-health after long service in an area known intimately by few others. Further, there is little direct stimulus to the acquisition of such knowledge, not merely by specialist agricultural officers, but by those administrative officers whose interests must very often extend far beyond their immediate duties.

251. We have in mind something much more far-reaching than the mere co-ordinating and filing of an indigestible mass of facts. We regard the central purpose of the proposed organisation as the ecological interpretation of the country and its mode of life. Some branches of survey are obvious, and do not need to be listed here. They would, of course, include topographical, geological and soil surveys, with an important section for plant ecology. The last, considered especially in the relation to the local native forms of agriculture, might very well be the central feature of the whole organisation. In this respect we would refer to the admirable pioneering work undertaken by C. G. Trapnell and J. N. Clothier in Northern Rhodesia.* An ecologist and agricultural officer were able in a few years to complete the reconnaissance survey of the ecology and agricultural systems of almost the whole country. They were able to show striking correlations between the two, and to offer interpretations and suggestions for future developments. This type of work has the great merit that it utilises the same kind of observations as the native uses instinctively in assessing the value of land. It is able to use local tradition and to employ African assistants to do work for which they are already well qualified, whatever their standard of book-learning. Once the main lines are understood the actual mapping can proceed comparatively economically. Naturally it is not claimed that vegetation mapping can be complete in itself, but it is the most suitable method for rapid reconnaissance, and it lends itself to any desired degree of elaboration in special areas with urgent local problems. The Northern Rhodesian survey was commenced in collaboration with a soil chemist, who was unfortunately retrenched. In any extended survey the soil chemist would, of course, need to work in intimate association with the ecologist and agriculturist in a search for more fundamental factors expressed in terms of the vegetation. In East Africa considerable progress has already been made by the soil chemist at Amani, working in association with the agricultural chemists of the individual colonies, in studying the soils of a few areas in detail, and using the relationships so discovered to provide an outline basis for co-ordinating the cursory impressions derived from hurried travel and contacts with non-technical workers with local knowledge. Once the main pattern is known the pieces of the jig-saw begin to fall into place. Till that stage is reached the individual is apt to be merely bored by bewildering complexity. In the equatorial provinces of the Sudan an economic botanist is at present making ecological surveys as a preliminary to agricultural development. The Sudan Government soil chemists have spent two seasons in studying and collecting soils, which are now being examined in their laboratories and in England. In addition, Mr. G. G. T. Morison, of the Soil Science Laboratory at Oxford, has made several expeditions to study the more theoretical aspects of soil formation in relation to geographical conditions and ecology. In the Belgian Congo both ecological and soil surveys have been made by expeditions from Belgium. An excellent ecological survey of the Niger Irrigation Scheme below Bamako has been made by G. Roberty, almost single-handed.

252. In those parts of Eastern Nigeria which have not yet had agricultural officers there is a good opportunity for commencing with a scientific survey of the vegetation and native agriculture. We have already pointed out that some of the most promising developments we saw were in those areas of the Northern Territories of the Gold Coast, and the coastal areas of Sierra Leone, in which the work began by detailed agricultural surveys. Throughout Nigeria the work originally began in much the same way, with a deliberate policy of studying the local agriculture and endeavouring to understand and improve on it before recommending any changes; but as the work expanded and became more practical the more purely scientific side has often been allowed to fall behind. It is largely for this reason that we propose the appointment of specialists who can combine work in new areas with visits to established centres where agricultural officers have to spend much time in busy isolation, without the opportunity of refreshing contact and collaboration with specialists keenly interested in their problems.

* "The Soils, Vegetation and Agricultural System of North-Western Rhodesia." *Report of the Geological Survey*, 1937, Lusaka, Northern Rhodesia. See also C. G. Trapnell, "Geological Methods in the Study of Native Agriculture in Northern Rhodesia," Bull. Misc. Information, Royal Botanic Gardens, Kew, 1937, p. 1.

253. It will certainly happen that the ecological surveys will reveal agricultural practices and problems needing investigations by field experiments. The ecologist will be able to assist in planning experiments on anti-erosion measures, but it may be necessary to appoint special soil conservation officers, who would begin by studying experience in the United States, East Africa and other countries. The Agricultural and Forestry Departments are at present attempting to control erosion on extremely meagre allowances, knowing full well that the whole subject calls for systematic survey and experiment. Drastic official action will have to be taken in the next decade or so in many parts of West Africa to safeguard soils for the future ; it is most desirable that this period should be used to the full, to ensure sound basis for such action.

FIELD EXPERIMENTS ON CROP ROTATION AND SOIL FERTILITY

254. Admirable work has been undertaken in Northern Nigeria and elsewhere in developing a system of mixed farming based on the farmyard manure produced by the cattle used for ploughing. We suggest that the time has now come when the more practical aspects of this work, which absorb a large part of the energies of the agricultural officers, should be supplemented by research on fundamental questions. There was little point in starting long-range work on soil fertility problems under the new system until it was known whether the scheme was in fact practicable. The method has certainly shown sufficient promise to justify a detailed analysis of its effects on soil fertility in comparison with the traditional Hausa methods of shifting cultivation, and with some compromise embodying features of both systems. The most important general question is to determine whether or not the land can be cultivated every year without such loss of structure as will allow serious erosion. It has been pointed out earlier in this Report that the West African relies on the hoe, even though the ancestors of some of the Northern Nigerian people must have known the plough in North Africa. Is it possible that at some earlier time the plough was tried in Nigeria and abandoned ? Does the marked wash of soil from the ridges of ploughed land into the furrow indicate that the soil crumbs are not sufficiently stable to stand up indefinitely to ploughing, or is such wash inevitable in soil with an appreciable amount of sand ? Should not contour-ploughing and broad-base terracing be employed more generally to get these ideas associated with mixed farming in the African's mind ? It must be remembered that whilst neat rectangular demonstration farms, suitable for long straight furrows, are being set up to replace the untidy irregular line of African farms, other demonstration farms are being set up elsewhere to show the danger of these methods and the importance of fitting the farm to its contours, so that soil wash is cut down to the absolute minimum.

255. It is almost certain that over-cropping and loss of soil organic matter or humus will proceed together, but it does not follow that all methods of restoring organic matter will be equally effective. A ton or two of farmyard manure or compost cannot offset the losses of soil organic matter or soil structure caused by cultivation after several years under bush, and it cannot reproduce all the effects of plants growing in undisturbed soil. In very poor soils the plant nutrients in the farmyard manure or in green manure crops may strikingly increase yields, but it is important to analyse these effects. Knowledge of the fundamental factors in soil fertility and crop nutrition is essential for working out any permanent system of agriculture. It would be most unwise to postpone investigations on crop nutrition and manuring until practicable schemes of mixed farming had been developed for various West African conditions, or to refrain from testing fertilizers on the grounds that African farmers are not likely to use them in the next few decades.

256. Mixed farming as at present developed in West Africa resembles what is known as the " soiling " system in Great Britain. Crops grown on the arable land are fed to animals kept in buildings. The traditional balanced farming in Great Britain has been based on alternating arable cropping with grass and clover leys for hay or grazing. Great progress with this system of " alternate husbandry " or " taking the plough round the farm " has been made in recent years through the work of Sir George Stapledon in improving ley plants and methods for establishing them. There may be greater difficulties in the drier parts of West Africa, where grasses have only a short season for active growth and rapidly become strawy. Some success has been obtained in establishing pastures at Shika and Dawdawa in Northern Nigeria, and at the latter place we actually saw grass being cut for hay by an ordinary mowing machine. There is much to be learnt about improving grassland vegetation by controlling the times of

grazing and firing. We saw a few modest plots on this question at Tamale Experimental Farm, but the subject should be attacked more wholeheartedly. Apart from pastures there are other promising ways in which grasses and other plants can be used to shorten or replace the resting period under bush. Pigeon peas might be left in the ground for more than one season, and the crop either cut for fodder or allowed to set grain. " Andropogon grass " is already being used in the Tiv country of Nigeria, and " Elephant grass " (*Pennisetum purpureum* Schum.) could be tried as a rotation crop in the wetter regions. We should like to direct attention to an excellent experiment laid down in 1937 at Serere, in the short grass region of Uganda.* Here attempts to maintain ploughed land in continuous cropping by green manuring had caused such rapid erosion and loss of fertility that most of the original farm had to be abandoned after a few years. The new experiment tests the effects of grass covers, both natural and planted, and green manures, each grown for one, two or three years with 0, 2½ and 5 tons of farmyard manure. Something along these lines is urgently needed in several parts of West Africa.

257. The history of field experimentation in Nigeria affords an illustration of the dangers which may arise from the unduly " practical " attitude. When Mr. O. T. Faulkner first set out on his sound policy of subjecting to actual test in the field all suggestions which might later be given to farmers, he was disturbed by the inadequacy of the design and the treatment of the results in general use in the field experiments of that time. He developed an improved method, consisting of alternating plots of some standard and some experimental treatment, with a statistical basis for expressing the results. This method represented a considerable advance, and it has been continued ever since in Nigeria. In the meantime, however, there has been a drastic revolution in both the theory and practical conduct of field experiments, as the direct outcome of the statistical researches of R. A. Fisher at Rothamsted. The new methods provide rigid tests of the significance of observed differences, and require replicated plots in random order. A variety of restrictions on the arrangement of plots may be used to increase the accuracy of the comparisons, and suitable designs have been worked out for almost all types of agricultural problems which can be attacked experimentally. These methods have already been used successfully by some of the specialist officers in the West African Departments, including Nigeria, but the more definitely agronomic experiments are still carried out by the old methods, which are undoubtedly far less efficient. A few large plots, commonly of a quarter of an acre each, cost about as much in actual labour and supervision as a much larger number of plots on a smaller total area using the modern methods. A few large systematically arranged plots cannot possibly give such reliable results, or cover such a variety of factors. The Faulkner method, admirable as it was when it was introduced, has definitely outlived its period of usefulness. Experience in numerous tropical countries has demonstrated beyond any doubt that properly designed experiments can be carried out by native labour of no higher standard than is available in Nigeria. Indeed, one can say that the standard of field experimentation is higher in some parts of the tropics than is general at home, partly because labour is cheap, but mainly because the vital necessity of getting reliable information rapidly has been properly appreciated. The adequate planning, analysis and interpretation of the more complex types of experiment need special statistical treatment. Agricultural officers who have held Colonial Agricultural Scholarships in recent years have had some experience of these methods, but there is room for specialist officers to advise on the more difficult questions and undertake the more ambitious statistical analyses. Such officers could also organise surveys, by modern sampling methods, for crop estimation. The West African farmer is apt to be unduly alarmed by any census of his crops or possessions, but surveys from very small samples, properly scattered over a wide area, would be free from this objection, and could be made to yield far more valuable data than more detailed work at a few spots. The trade of the whole coast varies so directly with seasonal fluctuations in the output of the main commodities that the traders themselves have recently appointed a statistician to initiate such surveys for crop forecasts. In the Department of Agriculture of the Gold Coast useful statistical work is already being done, and we should like to see it expanded to other branches of the department so as to ensure proper statistical control of all the experimental work. Too often the statistician is regarded as one who can make the best of existing data, but his services are most valuable in planning the methods of collecting the original data.

* W. S. Martin and C. E. J. Biggs, *East African Agricultural Journal*, 1937, p. 371, " Agriculture in Uganda," edited by J. G. Tothill, 1940, p. 79.

Meteorology

258. Considerable extensions in the meteorological service are to be expected from the development of air services, but the simpler observations, especially for rainfall, are greatly needed in some of the more remote places. Such data may be misleading unless they have been collected over long terms of years. Some decades hence important decisions of policy will have to be taken on such matters as forest reserves and soil conservation measures, which require the fullest possible climatic data. The vexed questions of the extent to which rainfall depends on forests, and the scale on which soil conservation methods should be employed, will remain controversial and uncertain until the experimental work undertaken can be viewed against a detailed knowledge of the climate over a sufficiently long range to bring out the extent of its variations. A great increase in the number of rain gauges reliably recorded would yield very valuable data a few decades hence. The location of meteorological stations is of importance. The present ones are often at District Headquarters, which in their turn have generally been selected for special amenities, climatic or otherwise, and are not always typical of the countryside.

Publications and Contacts

259. As air and other transport facilities increase it will be possible for more of the detailed laboratory work to be done at a well-equipped central station, or even in England. Already very useful work is done by the Imperial Institute and at other places in association with the specialist staffs. The Gold Coast Geological Survey maintains a centre in England, and some of its staff do part of their work in this country. Many of the specialists maintain contact during their leaves with research institutes at home. We are of opinion that the Governments should appreciate the value of these contacts to the extent of covering them by terms of special study leave.

260. Steps should also be taken to keep the individual agricultural officers in closer touch with the work of their colleagues and of those in other departments and colonies. Since the economic depression several of the publications devoted to West African agriculture have been abandoned or drastically curtailed. Agricultural officers often live very isolated lives, and have little opportunity of reading other works on similar problems, or of developing their own to the stage at which it can be published and subjected to informed criticism. From time to time occasional bulletins are issued on special projects, but these are less widely distributed than similar articles in a journal. We may mention that we found it difficult to obtain summaries of the results of the field experiments and other work of the departments, apart from a useful collection of papers, for the most part multigraphed, prepared for the West African Agricultural Conference of 1938. It is clearly unnecessary to attempt to issue journals in each of the colonies, but there is certainly room for a journal of West African Agriculture. The corresponding journal in East Africa provides an admirable medium for presenting the results of research work in the several Departments of Agriculture and Research Institutes, together with the experience of agricultural officers, planters and farmers. The circulation among the European farmers and the advertising revenue go some way to meet the cost of production, but in West Africa this would have to be borne mainly by the Governments. There would be no need to restrict the subject matter rigidly to agriculture : the journal might very well provide a forum for the exchange of information between the technical officers in several departments, the administrative officers, traders and others whose work depends on agricultural progress.

ACKNOWLEDGMENTS

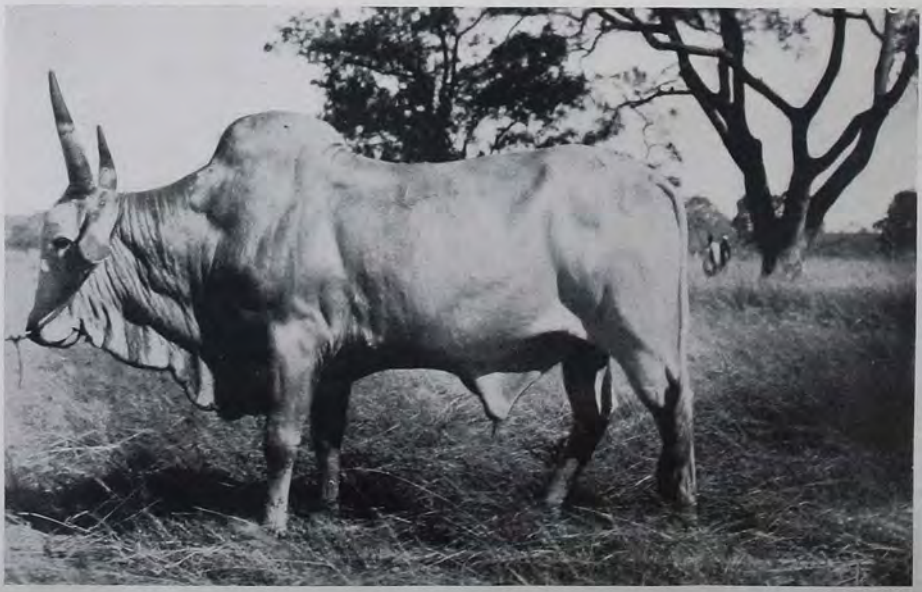
261. We desire to take this opportunity of expressing our warmest thanks to very many officials and non-officials in both British and French West Africa for the generous hospitality they extended to us, and our grateful appreciation of the way in which they placed at our disposal their fund of knowledge and experience.

ITINERARY

1938		
October	19th.	M.S. *Apapa*, Liverpool
,,	27th.	Bathurst, Gambia
,,	29th.	Freetown, Sierra Leone
November	1st.	Takoradi, Gold Coast ; U.A.C. Oil Palm Factory at Sessi, and the Friesta Plantation
,,	2nd.	Accra
,,	3rd.	Lagos, Nigeria
,,	4th.	Public Works Department, Produce Inspection, Lagos
,,	5th	Lagos Aerodrome, for grass establishment and management ; Department of Agriculture Farm at Agege, for citrus and reconditioning of cocoa farms
,,	6th.	To Abeokuta and Ibadan
,,	7th.	Department of Agriculture's Headquarters, Moor Plantation, Farm and Laboratories
,,	8th.	Country around Ibadan
,,	9th.	Forest Research Station, Ibadan
,,	10th.	Native Administration Cocoa Plots, Ajia
,,	11th.	Ilorin, Department of Agriculture Farm
,,	12th.	In train
,,	13th.	Kafanchan, and Agricultural Officer, Zonkwa
,,	14th.	Country around Zonkwa and Zongon Katab
,,	15th.	To Kafanchan and Jos
,,	16th.	To Zaria and Department of Agriculture's Northern Headquarters at Samaru
,,	17th.	Stock Farm at Shika and Veterinary Camp at Zana
,,	18th.	Mixed farms at Bomo village, Samaru Farm and Forestry Department Nurseries
,,	19th.	Department of Agriculture Farm at Maigana, and Sleeping Sickness Settlement, Anchau
,,	21st-22nd.	Empire Cotton Growing Corporation Seed Farm, Dawdawa
,,	23rd.	To Bakori, Mallim Fashi and Kafin Soli Demonstration Mixed Farms
,,	24th.	To Katsina and Daura ; visited Maiaduwa and Bumbum, and mixed farms
,,	25th.	Department of Agriculture Farm, Daura ; to Kano
,,	26th.	Mixed farms around Kano ; soil and rock exposures at Goron Dutsie ; Kano Experimental Farm
,,	27th.	To Samaru and Kaduna
,,	28th.	At Kaduna
,,	29th.	Geological Survey, Kaduna
,,	30th.	By train to Makurdi for Yandev
December	1st.	New Divisional Headquarters at Gboko ; Department of Agriculture Farm at Adeiyongo ; new Forestry Department Plantations
,,	2nd.	Yandev Farm—train from Makurdi
,,	3rd.	To Enugu ; inspected gullies above Milliker Hill and Forestry Department gully control measures at Udi ; motored to Umuahia
,,	4th.	Department of Agriculture's Farm at Umuahia
,,	5th.	Ahiara, a village with replanted oil palms and trials on manuring food crops
,,	6th.	To Oron, and by launch to N'Dian Estate
,,	7th.	N'Dian Estate and Factory
,,	8th.	N'Dian Estate ; night in launch *Balondo*
,,	9th.	Calabar Oil Palm Estate
,,	10th.	By s.s. *Oron* to Oron, and by car to Aba ; Aba Oil Palm Plantation
,,	11th.	Owerri School Palmery ; severe gullying at Mantua ; Department of Agriculture Farm at Onitsha
,,	12th.	To Benin
,,	13th.	Department of Agriculture Farm at Benin ; by car to Ibadan

Dec.	14th-15th.	At Ibadan
,,	16th-22nd.	At Lagos ; left by m.v. *Calabar*
,,	23rd.	Rice Swamp Trial at Warri
,,	24th.	At Calabar
,,	25th.	Arrived at Victoria, British Cameroons
,,	26th.	Plantations and native farms along coast
,,	27th.	Likombe Kamerun Banane Ges., and U.A.C. Banana Plantation, Tiko
,,	28th.	Buea, old trial ground, including Cinchona ; to Kumba
,,	29th.	Cocoa Co-operative Offices ; crossed to French Cameroons at M'Bana and motored to Duala
,,	30th.	In Duala
,,	31st.	Special train to Yaunde
1939		
January	1st.	Discussion in Bureau Economique ; Government Farm at Mvogho Betai
,,	2nd.	Special train to Duala ; sailed by m.v. *Calabar*
,,	4th.	Arrived Lagos
,,	5th.	Via Abeokuta, Ilori and Porto Novo to Cotonou, Dahomey
,,	6th.	Via Wida to Lome, French Togoland
,,	7th.	Agau Plantation near Palime ; Department of Agriculture Farm, Kpeve, Gold Coast
,,	8th.	To Accra
,,	9th.	Conference and Achimota College
,,	10th.	Aburi, Koforidua, New Tafo Cocoa Station, Bunso Estate
,,	11th.	Departments of Agriculture and Forestry, Accra
,,	12th.	Mankassim Food Farm, Assuansi Farm ; to Cape Coast
,,	13th.	To Kumasi, Produce Inspection Station, Cadbury Hall
,,	14th.	Ashanti Goldfield, Obuasi
,,	15th.	At Kumasi ; Lake Bosomtwi
,,	16th.	To Tamale
,,	17th.	Department of Agriculture Farm, Tamale ; to Pong Tamale Veterinary Farm
,,	18th.	To Navrongo ; Builsa Native Administration at Sandema
,,	19th.	To Lawra
,,	20th.	To Bobo Dioulasso ; village market gardens and sisal plantation and factory
,,	21st.	Through Koutiala to Segou ; cotton experiments and Botanical Gardens
,,	22nd.	To Sansanding and Medina de Kokr for rice irrigation
,,	23rd.	To Sansanding and Nono for cotton irrigation
,,	24th.	Via Dedougou to Koudougou
,,	25th.	Via Quagadougou and Navrongo to Zuarangu, Gold Coast
,,	26th.	Department of Agriculture Farm at Zuarangu, and surrounding country
,,	27th.	To Tamale
,,	28th.	To Kumasi
,,	29th.	At Kumasi
,,	30th.	Via Cape Coast, Secondee to Takoradi ; sailed on m.v. *Accra*
February	2nd.	Freetown, Sierra Leone, Department of Agriculture
,,	3rd.	Departments of Agriculture and Forestry
,,	4th.	By launch to Rokupr Rice Station
,,	5th.	Returned by launch to Freetown
,,	6th.	By car and train to Songo for Syrian Canary Banana Plantation ; to Masanki for Oil Palm Plantation, and Newton for Department of Agriculture Farm
,,	7th.	Department of Agriculture Rice Mill and Agricultural Officers' Headquarters Farm, Freetown
,,	8th.	Along coast road
,,	9th.	Sailed by m.v. *Adda*
,,	19th.	Arrived Plymouth

A herd of Fulani cows [PARA. 290



A humped bull (Fulani) [PARA. 290

PART II

REPORT ON LIVE-STOCK PROBLEMS

BY

LT.-COL. A. G. DOHERTY, M.C., M.R.C.V.S.

CHAPTER I

262. Live-stock conditions in West Africa can be said to fall naturally into two classes : those concerning the extensive belts of wooded country infested with tsetse fly, and those affecting the open fly-free country. A third class is being created by the Government of the Nigerian Territory. It has to do with the development of country intermediate between the two.

263. The types of conditions under which animals will be discussed can be referred to as :

(i) Social or ceremonial in the first class.
(ii) Mixed farming in the middle zone.
(iii) Purely pastoral in the range country.

It is necessary to bear in mind when considering this classification that Nos. (i) and (iii) are natural with age-long traditions, and No. (ii) is something new and experimental.

264. The people of this zone (i) are the various negro tribes of the south Ibo, Ibibio, Edo, Igua and Yoruba, so far as Nigeria is concerned ; in the Gold Coast, Fantis, Ashantis, Accras, Gongas, etc. In Sierra Leone the population similarly is not dependent on live stock. In the Gambia, a long strip of territory along the river banks, the people are more closely in touch with the pastoral lands, which makes live-stock conditions more akin to those of the middle zone in Nigeria.

265. The negro tribes, generally speaking, by tradition conform to their surroundings and are agriculturally minded. Fetishism, the prevailing religion, seems to be responsible for what live stock they keep rather than considerations of meat and milk for the local populations. The repression of human sacrifice by the Governments concerned has also tended to ensure the provision of animals for ceremonial occasions. The lethal disease conveyed by tsetse flies makes the keeping of animals in this zone too difficult for any animal industry to survive.

266. The middle zone may be said to apply to extensive areas in Nigeria and the Gold Coast. The development of animals for meat, milk and labour in this zone is dependent on the application of modern scientific methods. The work is in progress in both these territories. The aim is to establish a system of farming by which agriculturally minded people will be taught to cultivate on the principle of mixed farming. The units will be small. The animals concerned must be supported by the tilled land, and the farmers taught how to feed and manage them under these conditions. The fertility of the land, maintained by the manure of well-fed animals, will make regular cropping of the same land under a rotational system conform to farming practice in old-established farming countries. In this way the traditional practice of shifting cultivation should become unnecessary and more land become available for regular cultivation. Under this new system of farming, with the aid of working oxen, a family can cultivate by hand. With the manure from the farm stock the yield per acre is very much greater than without farmyard manure. So far the tendency is for the progressively minded native to double the area under the plough in the second year, and in the next two years to redouble the area under cultivation.

267. It is a heroic task to undertake this re-orientation of agricultural practice in primitive Africa. It is too soon to form opinions, as the work is still in leading strings. But it is safe to say that it will either be accepted by the native or it will not. In my experience the African can make his mind up very definitely on anything new that suits his conditions. And his opinion, in the long run, is the only one that counts, because no government has a long enough purse to impose new methods that are not in agreement with traditional practice in fundamental things like crops and live stock.

268. I remember two Masai moran inspecting shorthorn bulls that had arrived for a dairy farmer in East Africa. One of them was asked " Why don't the Masai breed cattle like these ? " His answer was the most eloquent imaginable. He walked to the feeding trough which had just been filled with crushed corn, bran, cake, etc., lifted a handful, and the answer was correct. It has been proved that exotic blood can do more harm than good under pastoral conditions in native Africa. I must confess to a similar feeling about the plough in West Africa.

269. To make adequate use of shorthorn blood the pastoral African would have to exert himself. To make adequate use of the plough, which slips so easily through the ground, the increased tillage will require the constant supervision of European staff.

270. In order to provide cattle for the attempt to introduce a system of mixed farming the Government of Nigeria maintains two stock farms : one at Shika, for the purpose of improving the zebu cattle of Northern Nigeria, and one at Ilorin, where the possibility of using the small humpless cattle from the tsetse areas on the coast is being explored. This resistance to tsetse-fly disease is the question at issue. In their natural environment they are undoubtedly resistant to the local strain of trypanosome. On mixed farms subject to invasion of tsetse fly they will have the additional risk of labour in the yoke to test their powers of resistance. These cattle are very suitable for the mixed farmer. I watched them ploughing, and they are a handy size and easy for an amateur stockman to manage. Their milking powers could be developed. Steps have already been taken in this direction at Pong Tamale in Gold Coast territory. At Shika the breeding of the Northern Territory zebu cattle is aimed at milk production. The white Fulani cattle show the same response to selection and management as do the boran cattle of East Africa, a breed they very much resemble.

271. The part that mixed farming will play in the production of meat and milk, or in the breeding of working oxen, is not apparent at this stage of the scheme's development. So far, practically all the farmers (there were 1,435 in 1937) have had their cattle purchased for them by the Department of Agriculture, who also buy the ploughs and train the oxen. I will refer later in the Report to small stock on mixed farms.

272. The pastoral fly-free range country of Northern Nigeria and the grass lands of Gambia both hold good prospects for successful live-stock development. In Northern Nigeria there is an area of approximately 50,000 square miles that has always been used by pastoral nomad natives for their flocks and herds. In the years gone by these people were the overlords of the larger Sudan, of which the most northerly belt of Nigeria is a part. They are traditional pastoralists with a well defined system of animal husbandry which suited their conditions. Their scope was always limited by water supplies, in a country where rivers are not permanent and rain falls for five months in the year. Wells dug by slave labour provided water for some of their herds during the dry seasons. The balance risked the tsetse-fly-infested valleys of perennial streams farther south.

273. For disease protection they relied on immunity naturally conferred by recovery from infection. The cost of this immunity to disease, like cattle plague and pleuro-pneumonia, both of which were always enzootic over the whole area of West and East Africa, was so high that there was no necessity to look for markets for surplus stock. Under favourable conditions frequent recurrence of cattle plague gave best results.

274. It was a regular practice with pastoral tribes like the Masai to introduce the disease to their herds when young stock were in optimum condition after the good grazing season following the rains. In this way they used the greatest measure of natural resistance to infection. As one can imagine, the mortality could differ within wide limits, depending on the average condition and health in the herd. Herds of susceptible cattle that were unfortunate enough to be infected at the end of a drought could be wiped out. These were the conditions prevailing on the pastoral belt of Northern Nigeria when Lord Lugard broke the power of the emirs and slave dealers. When conditions were sufficiently settled it took some time before the position could be improved. Communications made safe to the south opened markets for live stock. The numbers of cattle in the native herds gave an impression of wealth in stock calling for measures to facilitate marketing. The wealth, however, represented frozen capital that produced no real interest in the shape of marketable surplus. Lethal diseases like cattle plague, pleuro-pneumonia, blackquarter and anthrax, were accounting for the normal increases. In 1913,

before the real position in this respect was understood, a company was formed, The African Ranches Limited, to assist in marketing the surplus stock of the pastoral tribes. For what were felt to be good reasons at that time it was decided that a practical ranching scheme would be necessary in the first instance, and a considerable sum was spent in getting together the nucleus of a herd. Imported bulls were to be used, and a scheme was instituted under which it was hoped to establish good relationship with Fulani stock owners. In addition, steps were taken to interest the Hausa farmer, with a view to getting him to fatten stock, which would be purchased from him, thus providing an outlet for his surplus grain, and supplying him with manure for his cultivation. It was also intended to set up a crushing or extracting plant for groundnuts, which would provide groundnut-cake from the residue for feeding purposes. The intention was to erect abattoirs and cold storage plant in the producing area, and with cold storage cars to supply requirements in Nigeria and other parts of West Africa. After £80,000 had been sunk in seeking to prepare the way for the venture it was realised that it was premature, and was wound up.

275. When it was realised that wastage of stock from disease accounted for the live-stock increase over the 50,000 square miles of Nigeria's pastoral country, the question of practical measures to deal with cattle plague was discussed. A successful method was in operation in East Africa, where the proximity of herds owned by Europeans facilitated the education of native stock owners (see Kenya Department of Agriculture Annual Report, 1925, p. 51).

276. The African native, naturally conservative, is extremely suspicious of any departure from traditional practice where his live stock is concerned. He will resist strongly, not to say fiercely. He understands cattle plague and the lifelong immunity recovered animals enjoy. He knows it is expensive. The method employed in East Africa gave the same lifelong immunity at a fraction of the cost. With the assistance of the herds of settlers and traders the method was proved.

277. The Nigerian Government adopted the East African system of conferring permanent immunity. The difficulties were greater than in East Africa, where contact with European farmers had smoothed the path for the veterinary staff. The difficulties were overcome in time, as I have set out in another section of this Report.

278. To-day, the work of rinderpest control in Northern Nigeria involves the annual immunisation (permanent) of approximately 500,000 head of cattle and temporarily immunising a further 100,000 trade stock travelling to market. Pleuro-pneumonia, blackquarter and anthrax are also under control by immunisation.

279. Water conditions over the pastoral areas are also changing. The Geological Department have inaugurated a system whereby wells are provided. Already 1,800 wells have been dug, and their number can be increased to requirements.

280. It is evident, therefore, that the causes which have prevented the large areas of pastoral country in Northern Nigeria from contributing to the general welfare of its inhabitants and the colony as a whole have been recognised, and are being dealt with in a way that can now allow the still more difficult question of efficient marketing to be considered.

281. The grass lands in the Gambia that are fly-free present undoubted possibilities for their development on a live-stock basis. They are obviously suited for intensive dairying. I would strongly recommend an examination of suitable areas for that purpose as near to the coast as possible.

CHAPTER II

282. The produce of West Africa is well known on the markets of the world. Indigenous crops have been studied by the Governments in the several territories. Native producers, by demonstration and instruction, have been placed in a position to obtain better results from their agricultural activities.

283. West Africa is usually discussed in terms of agricultural produce. Live stock and live-stock products are not so well known.

284. Produce reaching world markets from West African live stock has, in the past, been mainly hides and skins. In the days before Lord Lugard gave the inland areas of West Africa

access to the western ocean the pastoral tribes reached the outside world by crossing the desert to the towns on the Mediterranean. Merchandise was packed on camels, and the journey took five or six months.

285. What the volume of the hide and skin trade was in those days is unknown, but during 1937 the numbers going through Nigerian ports were 678,240 cattle hides, 3,846,480 goat skins, and 679,000 sheep skins. These figures can allow of an opinion of the size of the flocks and herds owned by the pastoral tribes of the inland territories.

286. The position, however, is not capable of the same interpretation as in countries with an organised live-stock industry. In the absence of external markets absorbing surplus live stock one would expect to find evidence of overcrowding, but this is not the case. In a journey of 4,000 miles in Nigeria alone I did not see any signs of it beyond the inevitable destruction of pasture due to watering places that were doing duty for too large an area of pasture, with consequent neglect of grazing too far from water.

287. Live stock are the mainstay of life for the pastoral people on the semi-arid grasslands. Live stock are also kept by the inhabitants of the rich agricultural lands and in the belts of country where conditions are midway between agricultural and purely pastoral. Utilisation of these areas to any extent by live stock is not indicated on economic grounds, but limited numbers are necessary to ensure balanced nutrition for the people and to maintain fertility of the soil.

288. The high rate of wastage from disease amongst West African live stock has always been a controlling factor, and explains why areas that maintain such a large export of hides and skins have not had a surplus of live-stock products. In the northern areas cattle plague and contagious bovine pleuro-pneumonia, and in the southern areas, tsetse-fly disease, are the major causes of wastage that have so efficiently accounted for surplus live stock.

289. West Africa supports all the usual varieties of domesticated live stock—cattle, sheep, goats, pigs and horses.

Cattle

290. The cattle of West Africa can be put into three main classes : (i) humped cattle ; (ii) humpless cattle ; (iii) cattle of mixed humped and humpless blood.

291. (i) *Humped cattle.*—These cattle belong to the zebu family, a term applied to the humped breeds of Asia and Africa. Zebu cattle vary in size, conformation and colour as widely as our better known European breeds, and like them conform, generally speaking, to environmental and nutritional conditions. In West Africa we find them in the open country of the inland territories. They are owned by nomad pastoral tribes living under semi-arid conditions. With long distances to travel between pasture and water they must be good travellers. Unsuitable types have eliminated themselves. In this way we find greater length of leg and conformation on finer lines than we are accustomed to in a shorthorn or a polled angus.

292. The prevailing type of West African zebu is found in the herds of the Fulani. These people appear to have concentrated on light-coloured cattle with black points. They resemble in many respects a type of cattle found on the plains in eastern Africa between Lake Rudolph and the Indian Ocean. This is a good class of cattle with ability to react favourably to improved conditions.

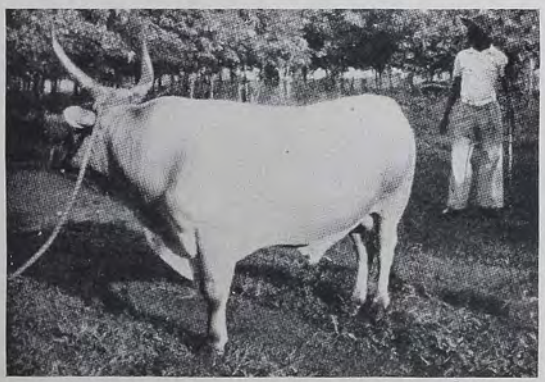
293. In the Chad area cattle of zebu type are bred with a smaller hump, a long back, and badly sprung ribs. Their large horn diameter is not unlike that of the cattle found in some areas of Western Uganda.

294. I saw a variety of types of zebu in West African herds. There has been interchanging of animals between closely related tribes residing as far east as the Bahr-el-Ghazal and as far north as the Blue Nile. Some of these bulls were very tall, and when fat could be massive. That type I was informed belonged to districts in the Anglo-Egyptian Sudan.

295. (ii) *Unhumped cattle.*—Into this class I put a type of small cattle I saw in the agricultural coastal areas from Nigeria to Senegal. They show no trace of zebu blood. In appearance they vary considerably, but not in type. The smallest of them I saw in Nigeria, where they are called dwarf pagan cattle. The best specimens were those bred at Fouta Djalon in French

[PARA. 290

Bull of mixed humped and humpless blood



[PARA. 290

Humpless bull

[PARA. 307

The African housewife's petty cash

Guinea. I could recognise a resemblance to our shorthorn in some of these little cattle. In others, brown swiss characters seemed to be dominant. They present an intriguing problem, these miniature shorthorns, miniature ayrshires, miniature brown swiss, miniature guernseys living amongst tsetse flies on the West African coast.

296. Captain J. L. Stewart, D.V.S., Gold Coast, has described them in an article published in the *Empire Journal of Experimental Agriculture*, Vol. VI, No. 21, January 1938. They are further discussed by the eminent zoologist, Dr. E. B. Worthington, in his contribution to Lord Hailey's *African Survey*.

297. Apart from the discussion of their origin in one or other of the foundation types of cattle in other countries, what struck me most was the attitude of owners to their cattle. I could not find any of the inherited cattle tradition amongst the villagers that is so noticeable amongst pastoral tribes. I do not think the coast people brought their cattle there, and they lack the incentive to go raiding from cattle tribes inland. These cattle are definitely not eastern in type. Their conformation is similar to western European breeds. Did they come from overseas? I was debating this point one day on the sea shore in the vicinity of one of the great castles constructed as forts by the early merchant explorers. These huge solid masses of masonry were not intended as temporary residences. The men who built them were accustomed to meat and milk. There is no reason to suppose that they did not bring cattle with them. Stabled in the outhouses of the forts, and hand fed, they would have flourished free from local diseases. Later, their descendants left behind would lose size in their struggle for existence under natural conditions. This is not a considered statement. It is a thought that came to me one evening when I was wondering how some people I was watching handling cattle came to have them; the kind of thoughts that never occur in company with Fulani, Masai, Samburu, or any of the pastoral tribes of Africa.

298. (iii) *Cattle of mixed humped and humpless blood.*—Cattle of mixed blood are most numerous in the areas where coast conditions merge into the Free-Savannah and Light Forest Zone. In some areas distinct types have been fixed. Usually the bull most recently used weighs the scale in favour of one or other of two types. The density of tsetse-fly infestation seemed to be the deciding factor. There is no question that the small coast cattle have a resistance to trypanosomes (the parasites injected into the blood stream by the tsetse fly) that is not usual in any other breed of cattle in Africa.

299. The conformation and character of these cattle of mixed blood follows closely that of the grade cattle of the settled areas of Kenya, where bulls of imported European breeds have been used by settlers on zebu cows for many years.

Sheep

300. There are no local breeds amongst the sheep in West Africa. They are drawn from a wide area in the Sudan. The types I saw had two characteristics in common. They were haired breeds with a thin tail. While the haired variety of sheep is usual and suitable for native African conditions, a fat tail as a source of cooking fat is met with in many parts of Africa. Its absence in West Africa is offset by the abundance of edible vegetable oils obtainable locally. Mutton is a prized delicacy on the West Coast, and sheep are especially fattened for ceremonial occasions.

Goats

301. There are many types of goat in West Africa. They vary within limits of size, colour and in the texture of hair. In the coast areas there is a dwarf goat, usually black in colour and symmetrical in shape in spite of his very short black legs. Although he is called a dwarf pagan I found myself referring to him as a dexter. He is to be found in all suburban areas living on refuse from vegetable markets. There is also to be seen the long-legged shaggy-coated goat of Nubian conformation, but the ubiquitous goat of the up-country territories is the red, brown or grey goat that furnishes a pelt so much in demand by leather workers everywhere. The red variety found in the Sokoto sultanate of Northern Nigeria has established an international reputation.

Swine

302. I did not see any pigs that could be called really indigenous and unimproved in West Africa. They all had a recognisable proportion of imported blood. Large white and

middle white have been the main importations. It is an interesting fact that the razorback variety of local pig is quickly susceptible to the influence of exotic blood, and the improvement appears to be easily maintained under West African conditions of food and management.

Poultry

303. Fowls are in evidence at every native village. They do not contribute as much as they could to the family larder. They are small and are eaten when half grown. Laying hens are rare. Turkeys thrive on the drier areas, and muscovy ducks are to be found in most places.

Donkeys

304. In the areas free from tsetse fly donkeys are used for pack work. They are the light-limbed, active type with a fine texture of hair covering a light-coloured skin. There are no mules bred in West Africa. During a 10,000-mile journey by road I saw only one in Nigeria and a few in French territory at Quagadougou and Sigon. It is interesting to note that the hardy qualities of the mule are not availed of in this part of Africa to the same extent as they are in North-East Africa where the Abyssinians breed large numbers of a very fine type. The explanation is that the horse is considered a noble animal by the Mussulman, and to mate mares with the ass, a low-born animal, is repugnant, a feeling that does not exist in Abyssinia. The White Fathers in Sigon province breed mules from Boussuma mares and Moroccan donkeys.

Horses

305. Horses are bred in the drier parts of West Africa free from tsetse fly. Generally speaking they are serviceable small horses of the light riding type. A gay appearance and lively disposition seem to be the chief aims of the breeders. The usual defects common to native-bred horses in Africa are too much in evidence. Practically all the riding horses I saw were stallions. The best quality horses I saw were bred by the nomad people of the Sudan. They make good polo ponies, going into the game with courage ; and on the race-courses, with welter-weights, show great gameness.

306. Many types are discernible, Arab, Syrian and indigenous, with every variety of crossbred.

307. Horses have always played an important part in the social life of Northern Nigeria, where they have ever been associated with pageantry. A thousand village head-men of a northern emirate, each mounted and adorned with robes befitting some special occasion, are a feature holding perhaps the greatest interest of all for the masses of excited but orderly spectators on a gala day or festival. Horse racing on modern lines is gradually taking a prominent place in the life of the people, and already polo is played by Africans at several places in Nigeria.

308. The Nigerian horse is essentially a riding type. The consistency of good shoulders and exceptionally good legs and feet are the best points of these horses. In size they are higher at the withers than I expected, and, indeed, higher than they look, as in other respects they are too lightly built. In discussing conformation with that grand old patriarch the Emir of Katsina, whose sons have their own polo team, he stressed the necessity for more substance in their horses. The emir is a horse lover of the old-fashioned type, and he has passed on this quality in full measure to his sons. I have very pleasant recollections of the day I spent with him. There are 26,000 horses in his emirate, of which 15,000 are mares.

309. While economically the use of horses is becoming restricted in proportion to the advance of motor roads, there are in Northern Nigeria 177,000 horses, including 93,000 mares. Their breeding does not command the same interest nowadays when most influential men have motor conveyances of some kind. At the same time horses and horse breeding lie very close to the hearts of the peasantry and their emirs. I had many interesting discussions with the older generation on horse-breeding questions. It was easy to arouse an intense interest, but behind it I sensed an atmosphere where time weighs heavily on their active spirits, a longing for adventure and sport so essential to the mediæval mind. It is hard for simple fighting men to change their whole idea of life. Rivalry in horses they can take a pride in at horse shows, on the race-course and on the polo ground, can help them in these days when law and order has introduced a sameness and monotony so entirely foreign to their instincts and tradition.

310. On questions of breeding I found general agreement that at the present time there is no method and very little incentive to select breeding material. In the absence of economic pressure the improvement of Nigerian horses cannot properly be called a function of government.

311. We at home are accustomed to see work of this kind organised by societies and associations of the people intimately concerned. Under changing conditions, and conditions are changing at whirlwind pace for the African in Nigeria, native opinion needs assistance in moulding the social side. Agricultural shows, race meetings and polo tournaments can be social gatherings of great importance. A battle for a championship, a hard fought finish for a breeder's stakes, or a final between two rival emirates on the polo ground can provide outlets for traditional rivalry in a modern spirit. There is a way, I think, in which our tradition in these matters can be moulded and utilised to-day in Nigeria. With the experience of only a few months in West Africa I am not in a position to put forward a completed scheme. I can, however, see the difficulties and possibilities. The main difficulty lies in the shifting European population, which like the shifting native cultivation is one of the main problems of the country. It should be possible, however, to organise classes at shows and to frame conditions for specific races at race meetings with a view to attracting the best types of horse. The classes of animals responsible for future generations are the most important, and in the initial stages of such a movement concentration on young mares would yield the most benefits to Nigerian horse breeding. Valuable prizes for young mares at shows, and well endowed races for mares up to four years old on the race-course, are essential for the success of such a movement. To ensure funds for prizes, therefore, will be an important preliminary. In a community like Nigeria, with its combination of official and non-official interests in the current problems of social and economic development—and these are twin responsibilities from the African union with western civilisation—it should not be difficult to form an advisory council that would act in conjunction with the native administration.

312. Hand in hand with the proposal outlined for the recognition of the best mares a scheme for the recognition of the most suitable stallions could be formulated, and in their case our traditional premium schemes, with modification, would be suitable.

Dogs

313. Another question, like horse breeding, belonging more to the social atmosphere, is dogs and their breeding in Nigeria. Native dogs are more in evidence in Northern Nigeria than in Southern Nigeria. They are used as guards and for hunting, and as such do not properly come under notice in a report of this kind. But I found quite an extensive trade in dogs from the Northern Territory towards Southern Nigeria which is worthy of more than passing notice. This trade is carried on by itinerant native traders, who buy them at villages and in markets. It is quite usual to meet these traders with twelve to fifteen dogs on their way south. They appeared to be dog traders, to the exclusion of other animals or merchandise. The profits on the trade would seem to be adequate. I was surprised to learn from discussions with the traders that there is always a demand for dogs in good condition at certain centres in the south, where they are usually eaten in connection with ceremonial or ritual of sacrificial offerings. I gathered from them that horses are also used for similar purposes and eaten by some tribes in Southern Nigeria.

314. The traffic to the south of horses and dogs is the constant concern of administrative and veterinary officers. Cases of cruelty are brought to notice, and offenders are punished. The destination of the animals and the manner of their ultimate disposal is also a matter for concern. Animal sacrifice dates back to antiquity. I was informed that in some cases horses or dogs are a modern substitute for humans. It is not easy to discuss the ethics of these sacrificial offerings which play such an important part in the lives of some African natives. On one occasion when I embarked on a discussion I was asked whether the God of the white man had sacrificed His Son.

315. The beliefs and customs of many people in tropical Africa are very real things. It is just as foolish to ignore them as it would be dangerous to interfere without careful and patient work towards a more satisfying doctrine. They are very earnest in their beliefs. In these matters it is wise to hasten slowly in Africa.

CHAPTER III

CATTLE CONDITIONS AND POSSIBLE IMPROVEMENTS

316. The conditions under which natives breed and keep cattle in West Africa must be reviewed before embarking on a discussion on what has been done with a view to the improvement of indigenous types. The discussion should, I think, be strictly confined within the limits of particular conditions. In my survey of West African live stock there are three sets of conditions under which cattle are kept by natives :—

(i) Cattle kept on rich agricultural land, where the people concerned do not consider them as an integral part of their economic life.

(ii) Cattle maintained on land that cannot be classed as pastoral or yet fertile enough to be used like the land in (i) above.

(iii) Cattle owned by pastoral people, for whom they are the chief means of subsistence.

317. My purpose in dividing consideration into watertight compartments like this is to avoid confusion of thought. In Africa and in England I have heard the question asked, " What is the use in Government spending time and money on live stock that natives keep, as a woman would a diamond tiara, for parading on special occasions ? " There is always the feeling that the diamond tiara is corroding the jewel casket or taking up space that should be occupied by something else.

318. An atmosphere of this kind can react very harshly on the people if we do not differentiate carefully as I have done above. Help can be denied to people who are suffering from malnutrition owing to loss of their live stock. It can also react detrimentally on the trade balance of any territory if large areas of pastoral land are not contributing their quota to the common good because of losses of stock from preventable causes. On the other hand, we are treating the land very harshly if we encourage the keeping of live stock on soil that is better suited agriculturally and economically to a different use.

319. In whatever manner or area we consider cattle desirable, whether it is from the point of view of human nutrition, milk, etc., and fertilizing of land in agricultural areas, or as the main industry of pastoral areas, we must remember that the same causes of wastage that brought the live-stock industry of Europe to a standstill in the early years of last century are in full operation to-day in West Africa.

320. I discuss elsewhere the major causes of this wastage. That they have existed so long amongst the herds in native Africa without forcing themselves into prominence is easily understandable. Animals that recover after a wave of pestilence are immune for life. This ensured a nucleus for a fresh start. A tightening of the belt, a murmured " Inshallah," and herds slowly accumulated until the next wave of disease.

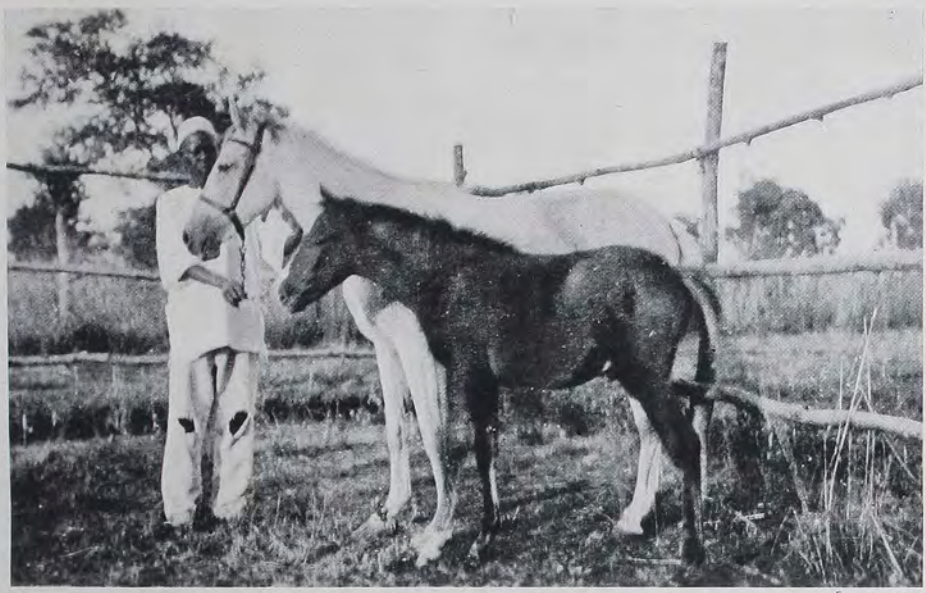
321. I also discuss elsewhere the economic control of these conditions, available for the governments concerned, and put forward a considered policy capable of adoption by all the governments in unison, including the administrations of other powers with similar responsibilities. Single-handed action by individual states can control cattle plague, but without efficient co-operation by all the governments concerned it cannot be eradicated.

322. Cattle cannot be improved beyond their environment and food supply, and these vary between wide limits in West Africa. Housing and hand feeding on cultivated crops can be economical on small holdings, but quite impracticable under range conditions in the pastoral areas.

323. I see no reason why dairy herds of suitably improved cattle should not be aimed at in the populous areas on the West Coast of Africa. During the whole of my tour I found it impossible to get a drink of milk anywhere on the coast.

324. This is an industry which should recommend itself to missionary societies. Capital outlay on buildings, plant, and stock is quickly repaid at a centre like Lagos, where the potential demand is great. The educative value of work of this kind would be difficult to estimate. Natives trained in the management of dairy cows and in handling and distributing fresh milk would be a valuable asset in communities that are unable to obtain fresh milk.

325. For dairy purposes, under conditions of housing and hand feeding, exotic blood of good milking breeds can be used with advantage.



Horse breeding in Nigeria

[PARA. 305

Milking time in Gambia

[PARA. 337

326. I do not know any exotic blood that could be introduced with benefit on the range country of West Africa. With the experience of similar areas in tropical Africa to guide us, immediate response can be obtained in herds of indigenous cattle by providing water facilities that will ensure the efficient utilisation of pasture. In this way the provision of adequate water must follow disease control before the stage is set for breed improvement by selection.

327. When discussing live-stock conditions of the Northern Territory of Nigeria it is necessary to keep in mind that until Lord Lugard took over the administration of the territory now known as Northern Nigeria that country was incorporated in the larger area that stretched from the Abyssinian highlands in the east to the watershed between the Niger and Senegal Rivers in the west. The Fulani, with their live stock, lived nomad lives over it subject to the rule of their emirs. Like all pastoral peoples on such areas their lives were governed by rainfall, water supplies and pasture conditions. As the dry season advanced, areas like the Bahr-el-Ghazal—where during the rains the creeks and water channels that intersect it flood the land, receding to leave abundant pasture during the dry months—became favourite grazing grounds. Up to a few years ago Fulani herds from the Chad area were accustomed to move in that direction in search of grass. In this way the inhabitants of the regions east of Nigeria have close connections with the tribes in Nigeria. In particular, various Arab tribes outside Nigeria regard sheiks living in that country as the real heads of their units. Maiwurno, the cousin of Abubukar, Serikin Mussulman, Sultan of Sokoto, lives at Shepie Talka near Sanaar on the Blue Nile.

328. The Anglo-Egyptian Sudan lies 842 miles from the Nigerian border. This intervening country comprises fertile stretches rich in cattle, camels, horses and sheep, which are grazed on fine pasture lands. The inhabitants of these regions of French territory have close connection with tribes in Nigeria, historical and religious; in particular, various Arab tribes regard sheiks living in Northern Nigeria as the real heads of their units.

329. Some years ago the French estimated that there were 1,000,000 head of cattle in this region and that the pastures would support double that number. Cattle plague is a serious trouble in the French Sudan. In 1929 Monsieur M. G. Brevie, Gouverneur du Niger, stated to a representative of the Nigerian Government that almost all their big cattle epidemics came from the east, and suggested the danger of their entering Nigeria from the east and passing on to the French Colonies to the north and west of Nigeria.

330. During 1936 cattle plague of a virulent type swept over the northern Anglo-Egyptian Sudan. The following year it was raging in the southern provinces. The question of whether there was any justification for suppressing it was discussed, and it was decided a case had not been made out. In this way water supplies for stock are balanced. In the Northern Sudan, and as far as possible in the Southern Sudan, a temporary immunity was given by the inoculation of serum or vaccine.

331. It will be seen from the foregoing that for Fulani stockowners to confine their stock within the boundaries of Northern Nigeria is something to which they are unaccustomed, both by their tradition and their methods of stock management. The area which is of chief concern to them under the altered boundary conditions is the semi-arid belt which lies between 12°N. and 14°N. Lat. along Nigeria's northern border. It is 600 miles from east to west and 100 miles from north to south. It involves approximately 50,000 square miles, and embraces the emirates of Sokoto, Katsina, Katagum, Kano, Hadejia, Gwanda, Gumel, Duara, Bornou and Argunga. The pastures over this large area have to be vacated each dry season because although the mean rainfall for the whole area is between 20 and 27 inches it is confined to five consecutive months in the year. During the remaining seven months most of the rivers dry completely. Nowadays, under the altered conditions, the tendency is for the native owners to take their cattle southwards in the dry seasons and graze the areas in the valleys of the perennial rivers. These harbour tsetse flies, which cause a varying amount of wastage each time they are visited. The provision of sufficient water to carry these pastoral tribes and their stock through the dry seasons on the northern belt is engaging the attention of the Nigerian Government. The Geological Survey have a special branch dealing with this most important work. Already more than 1,800 wells have been sunk in the area, and the work proceeds.

332. A point of interest occurs here in connection with these preparations to utilise in a fuller manner the pastures of this northern belt—the question of the encroachment of the

desert from the north. The Director of Geological Surveys, Northern Nigeria, states in a memorandum that " there is no evidence that the habitability of the northern provinces of Nigeria is being threatened by a deterioration of climate or by desert invasion." He further stated, with regard to overstocking and soil erosion, that " In Nigeria the problem of erosion is bound up with the native system of agriculture. There is little or no overstocking except perhaps in some heavily farmed localities. The area of bush (pasture) land is so great that the country could support a considerably higher cattle population provided adequate water facilities are constructed."

333. Live-stock improvement on range country is the active concern of three quite distinct branches of science—veterinary science, engineering science, and agricultural science. The veterinary surgeon establishes security from disease ; the engineer establishes adequate water facilities ; and the agriculturist establishes improved pasture conditions. Where an area is large enough to warrant the whole-time services of three experienced officers the formation of a live-stock centre for the co-ordination of the work is of material assistance.

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334. The question of live-stock development on the rich agricultural areas has given way to the more important needs of the population for crop production. Land of this kind is too valuable for stock breeding to any extent in native fashion, and intensive methods of husbandry are not understood locally. Education in this direction must precede any attempts to aim at better stock with a view to their economic utilisation.

335. The position of live stock under the conditions obtaining on land classed as Middle Belt is under examination. The problem is being attacked with vigour, and it is many sided.

336. The area concerned is subject to stock diseases that can be controlled and water difficulties that can be overcome. The stock owners are not accustomed to housing and hand feeding their stock, traditional methods being communal management on natural pasture. The system aimed at is the establishment of small holdings of agricultural land, each with its complement of live stock. Cattle, sheep and goats will be expected to play their part in contributing to the family food supply, tilling the land and maintaining fertility with their manure.

337. The major diseases, cattle plague, pleuro-pneumonia, anthrax, blackquarter, can be adequately dealt with by immunisation. Tsetse-fly disease which is enzootic over this class of country has also to be guarded against. For this purpose the natural immunity of the humpless cattle indigenous to the coastal regions is to be exploited. These cattle maintain their resistance to trypanosomes under normal conditions, which, up to now, have not included work in the yoke. It will be essential to ensure against lowered condition, which would induce a breakdown of the resistance which affords the immunity they enjoy against tsetse-fly. The objective aimed at by the Government of Nigeria is to establish conditions that will enable natives to use land of this kind in a way hitherto impossible for them. Its success depends on separate dwellings for families. To overcome the reluctance, especially of the women folk, to isolation, the necessity to allow for the ordinary amenities of village life must be recognised. No married woman likes to be without a few goats. They play a part in her life quite outside the understanding of the modern economist. Much has been written in recent years with regard to the menace of the goat in native Africa, so perhaps a brief mention of the facts about them would be useful while the subject of mixed farming is being discussed. For more than ten years the estimated goat population of Nigeria has varied only by two to three thousand above and below five million. The average increase has been calculated at 140 per cent per annum. " *Leur qualités prolifiques en font une des ressources les plus appréciées des villages. Leur lait est excellent. La viande est bonne qualité, surtout chez le chevreau* " is how they are officially considered in French territory. The part they play in ceremonial usage, so dear to the native heart, is also near to the stomach, because the feast would be impossible without the sacrificed animal. Furthermore, the goats are the absolute property of the woman of the house, who withholds or gives at her discretion.

338. I have gone into the question at this length because I believe that official feeling will prohibit the keeping of goats on small holdings if it is possible to do so. If they are not allowed it will be difficult to find a substitute in the family *ménage*. Natives do not allow goats to damage their food crops. They are tethered during the growing season.

339. The extreme northern belt of the Northern Territory of Nigeria is the home of the country's live-stock industry. It is an area of approximately 50,000 square miles, where the pastoral people, of necessity, live nomad lives with their flocks and herds. Their movements are determined by pasture conditions, which in turn depend on several factors. Grazing is not equally abundant over the area ; grasses vary in food value ; and seasonal variation affects some pastures more than others. These conditions are affected by the rainfall, which is monsoonal in character. The mean annual rainfall for the whole belt is between 20 and 27 inches. At Lake Chad in the east it drops to 12 inches. The rainfall is confined to five months in the year, so its value to the herds is limited. During the dry months most of the rivers dry up, so cattle are moved long distances southwards to the water in the valleys of the perennial river system, where tsetse-fly infestation is a danger.

340. It has not been the custom of the nomad pastoralists to make hay or grow fodder crops for their stock in the lean season when they move in search of fresh pastures. There are two reasons for this traditional habit of life. First, it was essential to live in a state of preparedness to move when disease appeared in their herds. Cattle plague was always somewhere hovering about, and the only weapon these stockowners knew was to move away from it. Second, the water supplies at any centre could not maintain their stock through a dry season even if abundant forage was available.

341. The position as I saw it in Nigeria is changing. The fear of disease is being dispelled by government action in immunising against disease. The numbers treated in this way by the veterinary service are truly remarkable when one considers the state of affairs only a few years ago, when the inhabitants of that area resisted Lord Lugard so fiercely in defence of their trade in slaves. During 1937 the number of cattle immunised against cattle plague was 639,594. Contagious pleuro-pneumonia has also to be guarded against, and 138,249 cattle were protected by vaccine. In addition, losses from blackquarter and anthrax have always been a cause of anxiety to the native owners. A total of 427,284 cattle were immunised against blackquarter and 34,245 against anthrax during the year. The wastage from tsetse-fly disease when herds have to be driven to water in dangerous areas has also been alleviated, and 8,003 cattle received prophylactic injections.

342. I was interested to observe that these measures were not being forced on native owners. Their confidence in the security afforded is now the driving force behind their demands for veterinary assistance. Some years ago the question of supplying the native communities with sufficient water for the domestic needs of the inhabitants of the area and their live stock was investigated by the Nigerian Government. There were wells in existence dug by slave labour under the direction of Mohammedan emirs. It was found that underground water was available. A special branch of the Geological Survey was formed, which carried out experimental work in well sinking. A special technique was devised that could be adapted to sinking and lining wells in different types of ground met with.

343. The native administrations of the emirates of Argunga, Bornou, Duara, Gumel, Gwanda, Hadejia, Kano, Katagum, Katsina and Sokoto financed the well-sinking operations. Water supplies involving large capital outlay and heavy maintenance charges have not been aimed at. The simplest and cheapest methods for raising water suitable to a primitive and conservative people have very wisely been adhered to. So far 1,800 wells have been sunk. Some are as shallow as 50 feet and others 380 feet deep, but the average depth is about 100-150 feet. The permanency of these wells and of the underground water are important questions. With regard to the latter, I am assured by Mr. R. C. Wilson, the Director of Nigerian Geological Survey, that there is no reason to suppose that the water table will not always be available at about its present level. The wells themselves, lined with reinforced concrete, are permanent structures capable of being maintained with a minimum of expenditure.

344. With the control of stock disease to the satisfaction of the inhabitants, and the knowledge that underground water can be cheaply and efficiently made available, Nigeria's northern pastoral belt can now be considered as capable of development for a better rôle than hitherto in providing for its own needs and for the meat requirements of outside markets.

345. To alter traditional methods of stock management and marketing to conform to the improved conditions is the task that lies ahead, and it presents more difficulties than the

work that has been accomplished. There is one great advantage, however, that must not be lost sight of. Government has gained the confidence of these people by the security now afforded from the diseases that have decimated their herds in the past. Thus a favourable atmosphere is created for the alterations now necessary, so that the pastoral natives may reap the benefit of the work that has been done for them.

346. Pastoral nomads do not understand the management of pastures and forage crops under settled conditions. This will require careful demonstration by Government. Marketing methods at present used by these people are extremely wasteful. These two questions will bear examination in some detail. The interests involved are threefold—Government, commercial, and native owners.

347. The education required to effect the changes in management must begin with demonstrations on simple ways of providing food for stock over the dry seasons. This is the keystone on which all future development will depend. It can be done by rotational grazing or the growing of forage crops, or by a combination of both methods. When success has been achieved the questions of breed improvement and conditions required for the preparation of animals for market will follow.

348. Demonstrations of this kind can be most effectively carried out at a farm controlled by an experienced live-stock officer. It is not work that could be understood by a large number. The seven months of the year without any rain, with humidity very low, and a mean day maximum temperature that rises to 109° Fahr., create conditions not usual to the average stockman. But good cattle are raised under these conditions very cheaply.

349. I would again emphasise that the difficulties lying ahead of bringing to a successful issue the years of patient work by veterinary and engineering services are very real. Native owners held back from the immunisation against disease until they were satisfied about the benefits. Their satisfaction to-day is illustrated in the demand for immunisation.

350. The raising of water in arid areas brought forth the financial provision from native treasuries. The labour required for the change over from nomad to settled conditions will not arouse enthusiasm without a prolonged effort on the part of those engaged in the task.

CHAPTER IV

MARKETING

Nigeria

351. The surplus stock is marketed in Nigeria. A few slaughter animals are exported by sea to the Gold Coast. Some 3,157 cattle and 1,205 sheep and goats were shipped to Accra during 1937. During the same period 32,104 cattle and 27,455 sheep and goats were railed from the north to Southern Nigeria. In addition to these, 94,396 cattle and 85,000 sheep and goats went south by road.

352. The marketing organisation for live stock in Nigeria is a complex one. Its complexity must be thoroughly understood before any improvements likely to be successfully used can be considered. Like trade between natives in any part of Africa the credit ramifications are endless. Producers frequently wait long periods for payment ; sometimes they share the marketing risks, at the end of a long journey through tsetse bush, with the trader. The risks of these journeys are so well understood that if cash payments are made they do not represent a fair return for the animals sold by the producer.

353. Itinerant buyers are financed by dealers who usually have large amounts of money out. In this way vested interests have existed since trade in live stock to the south was possible. The African live-stock dealer, like his prototype in other countries, loves a gamble, but the primary producer in Africa usually is not sufficiently intelligent to understand how the game is played. Nature has provided the setting. No one can tell how many animals will live to reach market on a journey through tsetse bush, or the number of forced sales of sick animals en route.

354. I made careful observations on this trade during my tour of Nigeria. I was able to inspect mobs of slaughter cattle at Kano, Katsina, Sokoto, Zaria, Kaduna, Zungeru, Jebba,

Ilorin, Ibadan, Abeokuta and Lagos. I was able to see also small mobs of slaughter cattle at Kafanchan, Abuya and Bida. Grass was plentiful as it was November, the month following the end of the rainy season. My most informative inspections were on the road when I met travelling stock in charge of native herdsmen.

355. With the exception of stretches of road in the Ilorin area no provision is made for stock moving south to market. They share the main motor road with lorry traffic, which increases in volume towards the coast. I was not able to make comparisons on any individual mob of cattle at the different stages of the journey, so the opinion I have formed is based on the general condition amongst the travelling cattle I saw at the places mentioned. Nor do I know what the conditions are like as the dry season advances.

356. At Abeokuta and Ibadan the incidence of emaciation due to tsetse was high, yet curiously enough the thin animals were favoured by the local butchers because the price was low. Even at the lower cost it was difficult to see how the small amount of meat on the skeletons could get back the initial outlay unless very high prices were charged at the butchers' shops. (Natives do not buy bones to the extent we are accustomed to in a sirloin or similar joint.) This I found to be the case. Meat was three times the price when I was at Ibadan compared with Kano prices.

357. The high incidence of tsetse infection I saw may not be common all the year round. After the rains, with abundant moisture everywhere, tsetse flourish. The cattle that had escaped infection or were not yet showing symptoms were lean but not emaciated. Compared with average mobs I saw at Kano, Katsina, Sokoto and other towns in the producing areas, the loss in weight was what one would expect after a journey of this sort. I had no opportunities for weighing animals, but judged by the eye I would average the difference in weight between the northern slaughter bullocks I saw at Ibadan and those in the markets of the northern towns at 20 per cent in the healthy animals. Those infected with tsetse-fly disease were in every stage of emaciation. So long as they could walk they would be bought up by local butchers. It is surprising how long animals whose blood stream is swarming with trypanosomes will eat and travel while getting progressively thinner.

358. During the dry seasons the incidence of tsetse is not so high, but scarcity of grazing on the roads leads to much loss of condition in travelling stock. At no places *en route* is provision made to store fodder.

359. The slaughter stock I saw at Lagos had arrived by rail from Kano. They had completed a journey of 50 hours in open trucks. They were a very mixed consignment considering they were all intended for immediate slaughter. Some were in prime condition. These I learned were for shipment to Accra, where prices rule 100 per cent higher than at Lagos.

360. The rail journey from Kano is made without a break. The cattle trains are loaded early in the morning. The regulations governing rail transit compel a rest of twelve hours in the lairage at Kano before cattle may be entrained. According to regulations governing the transit of cattle in England a journey of fifty hours without water or food would render the railway company and the owner liable to prosecution. If we examine Nigerian conditions and the class of cattle under consideration the question of effecting further improvements is seen to be difficult. Zebu cattle are accustomed to lengthy intervals between waterings. Watering and feeding in the trucks has led to many casualties. If they are unloaded at a half-way station the added excitement of off-loading and re-loading causes much hardship, and excited, nervous animals are usually disinclined to drink or feed.

361. It must be admitted that the present methods of marketing the stock produced in the pastoral areas of Nigeria is inefficient and extremely wasteful. Lord Harlech refers to it in a report, C.M.O. 2744, p. 84, in which he gives the figures of wastage at 50 per cent amongst cattle driven south for sale year in and year out.

362. There are two ways in which permanent improvement can be effected—

(i) To organise stock routes with a view to eliminating wastage.

(ii) To organise the slaughtering of live stock in the producing areas, and the distribution of meat in trucks and vans constructed to accommodate perishable food.

363. The wastage amongst stock travelling by road from the northern pastoral areas to the markets of the south is due to malnutrition on the journey and infection from the tsetse fly.

Both the causes can be guarded against. Stock routes organised with a view to adequate grazing reservation and the provision of fodder when necessary, together with an inoculating service for prophylactic medication at suitable intervals on the road, could effectively deal with the position. Action along these lines would be a suitable and necessary sequel to the splendid work in progress amongst the breeding herds in the north, where the disease control by the veterinary staff is making such progress.

364. A reorientation of the entire system of meat distribution by means of cold storage is one that makes a strong appeal on economic grounds.

365. The numbers of stock involved, the sources of origin and the ground to be covered by distributive machinery can be discussed. The official live-stock return for 1937 shows the total numbers of cattle, sheep, goats and swine to have been—

Cattle	3,052,279
Sheep	1,919,601
Goats	5,620,250
Swine	66,169

366. These figures are not accurate, as they simply record the number of these classes of animals on which tax has been paid. The Director of Veterinary Services says " It can be taken for granted that in the case of cattle, especially, the figures are far below the actual numbers."

367. To meet the demand for meat large numbers of cattle, sheep and goats are imported into Nigeria annually from French territory. In his annual report for 1937 the Director of Veterinary Services says : " The numbers of sheep and goats are not under control, but *it is estimated* that 120,000 cattle entered Nigeria this year through Veterinary Inspection Station on the border."

368. The consumption of meat, apart from pork, in Nigeria, as shown by official returns from recognised slaughtering places, is 376,493 cattle, 314,536 sheep, 1,017,060 goats and 9,661 pigs. The number of animals killed for food at unrecognised places is impossible to collect. In order to arrive at the total number of animals used for food during 1937 the Director of Veterinary Services has used the export figures for hides and skins, assuming that 20 per cent of those exported were in transit from French territory. The figures thus arrived at are as follows :—

Cattle	678,240
Sheep	679,000
Goats	3,846,480

369. If the 120,000 slaughter cattle, estimated by the Director of Veterinary Services as imported from French territory during 1937, is deducted from the cattle figures shown above the number of locally produced slaughter cattle is 588,240. The size of the herds necessary to produce this marketable surplus under native African conditions cannot be estimated at a lower figure than 5,582,400. The opinion of the Director of Veterinary Services, therefore, that the cattle population as shown by the taxation register is an under-estimate is correct.

370. In arriving at my estimation I have used 10 per cent as the marketable surplus, and this is an optimistic figure amongst herds subject to enzootic cattle plague and contagious pleuro-pneumonia, with prophylactic measures in the initial stages.

HIDES AND SKINS

371. Improvement in marketing methods of hides and skins in native Africa have not kept pace with improved methods of preparation. Hide and skin buying cannot be compared to the marketing of crops. Crops are seasonal and localised. Hide and skin buying is continuous and general over the whole country. At the moment, under native administration laws in West Africa, an African can be punished for selling badly prepared hides, but the buyer cannot be punished for buying such hides. The trader accuses the stockbreeder of bad faith. Traders are not employing methods which would encourage the African to use improved methods for the preparation of hides for market. I would suggest legislation for the hide and skin trade along the lines used in Kenya in the early days of cotton production, whereby traders were compelled to remain at fixed posts where they could be subject to a certain amount of inspection and where accurate trading books are kept for inspection. In this way it will be possible to see that better prices are paid for the better quality hides.

[PARA. 392

The dairymaid at work. Butter-making with a swizzle stick in Gambia

[PARA. 281

Milking with both hands. Modern style in Gambia

[PARA. 371

Preparing hides for market. New method suggested by Associated Tanners in England

CHAPTER V
CATTLE PLAGUE

372. In the middle of the 19th century cattle plague was decimating the herds of Europe. The disease came from the East. From Tartary it spread over the regions of the Don and Vistula, infecting practically every country in Europe. Moscow, Poland, Hungary, Prussia, Austria, South Germany, Switzerland, Italy, France, Holland, all suffered heavy losses. By the year 1852 there are records showing that Denmark had lost two million cattle from cattle plague.

373. The disease reached England in the year 1864. It is interesting to-day to note that in 1864 no one in England or on the Continent knew the cause of cattle plague. This is clearly shown by the following extract from a newspaper published in England in 1865 :—

THE DAY OF HUMILIATION

Wednesday last was observed throughout the diocese of Gloucester and Bristol as a day of humiliation. The following form of prayer was used by the clergy :

" O Lord God Almighty, whose are the cattle on a thousand hills, and in whose hand is the breath of every living thing, look down, we beseech Thee, in compassion on us Thy servants whom Thou has visited with a grievous murrain among our herds and flocks."

Churches were crowded. The principal points discussed were—

(i) The cause of the plague—our sins in their innumerable forms.

(ii) The incurability of the disease—having baffled all medical skill.

374. That happened only seventy-five years ago. When the helplessness of the position had been made plain in the churches, Government called together men of experience who were careful observers of live-stock conditions. Their discussions led to the formation of a State Veterinary Service, which devoted its entire energy to solving the problem. The disease was eradicated, and a set of regulations drawn up which has prevented losses from cattle plague in England since that time.

375. In Africa there is no available record of rinderpest, outside Egypt, prior to the year 1864. In more recent years there are definite records showing that cattle in eastern Africa were dying from the disease in 1891.

376. By 1897 cattle plague had reached the farm lands of South Africa, where twenty million pounds' worth of cattle perished from the disease before a veterinary service could be formed to deal with it effectively.

377. When the territories of East, Central and West Africa were administered sufficiently to admit of the live-stock position being examined by veterinary science it was found that cattle plague had a firm grip over a large area stretching from the Masai country in East Africa to the pastoral lands of the Sudan and West Africa.

378. The different governments concerned have formed veterinary services. Investigations amongst pastoral people like the Masai revealed that they knew the disease very well and had evolved ways of their own for dealing with it. They knew game animals suffered from cattle plague ; they also knew that if cattle recovered from the disease they were immune for life. Under the conditions in those days the pastoral areas of tropical Africa could not market produce on external markets, and the very expensive method of obtaining immunity by natural infection allowed of sufficient cattle for local tribal requirements. Temporary deficiencies could always be made good by raids on weaker neighbours.

379. The breeding of cattle under European control in Kenya provided the necessary setting which afforded adequate facilities for the examination of the cattle plague position by scientific workers. Experimental research amongst the herds of European owners over a period of years was finally crowned with success. The solution of the problem lay in the discovery of a technique that would give cattle the same immunity against the disease as the African stock-owners were accustomed to in their own primitive system of animal husbandry.

380. By the year 1925 the position can be shown by the following extract from the Annual Report of the Kenya Veterinary Service for that year, p. 45 :—

A financial statement as follows can represent the result of the year's work on anti-rinderpest measures by the Veterinary Service.

For the purposes of the statement an estimate of £1 10s. od. per head is given as an average value for all classes of stock immunised ; the majority of native stock now being presented are young animals.

Immunity by the primitive native method of immunity *naturally* acquired :—		
185,000 head of cattle at £1 10s. od. per head	£277,500	
50 per cent mortality	138,750	
		£138,750
Immunity by *modern method* of immunisation :—		
2.2 per cent mortality	£6,105	
Inoculation fees at 2s. 6d. per head	23,125	
Cost of immunity		29,230
Economy effected by inoculation method		£109,520

381. Cattle plague control and eradication was discussed at the Eleventh International Veterinary Congress held in London during August 1930. The Congress was attended by delegates from 39 foreign nations, 20 British dominions, colonies, or dependencies, and from 43 counties and municipalities in Great Britain and Ireland. During the discussion, Doctor Nicolsky, the Russian representative, described the measures which had been undertaken by his Government for the control and eradication of cattle plague. He informed the Congress that during the years 1925-26 the Russian Government had devoted 20.6 million roubles ; in 1926-27 27.3 million roubles ; in 1927-28 34.3 million roubles ; in 1928-29 45.7 million roubles ; in 1929-30 61.5 million roubles. With this financial provision the campaign against cattle plague had been created. In 1928 cattle plague was exterminated in the U.S.S.R. Special stations for the manufacture of the necessary biological products against cattle plague had been established, and active measures were in progress against the possible reappearance of the disease from eastern states. After further discussion the following resolution was passed unanimously :—

> That this Congress considers that sufficient knowledge of practicable methods is now available to eradicate rinderpest within a reasonable time in any country which will provide adequate facilities for their application, and Congress urges upon all governments to co-operate to this end.

In the four Crown Colonies in West Africa with which this Report deals cattle plague is enzootic, as it is in French West Africa, French Equatorial Africa and the Anglo-Egyptian Sudan.

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382. The country was first examined by a veterinary surgeon in 1913. When the 1914-18 war was over, and it was possible to create the nucleus of a veterinary service, plans were made to deal with rinderpest in the Northern Territory of Nigeria. The stock-owning pastoralists are Hamites of nomad type, common to the vast area lying south of the Sahara and stretching from the watershed between the Senegal and Niger Rivers in the west to the Abyssinian foothills in the east. Before international boundaries brought them under three administrations, French, Anglo-Egyptian and British, their nomad lives were governed by tribal ability to ensure sufficient pasture and water for their stock against stronger neighbours and periodical waves of rinderpest which decimated their herds at regular intervals.

383. It took some time for the veterinary service to make a survey of the position over an area of approximately 50,000 square miles. The conservatism of primitive pastoral people, and their blind adherence to the husbandry methods of their forefathers, had to be understood and studied. Their inherited cattle husbandry had for its keystone immunity to disease naturally acquired. Their animals that recovered after each visitation of rinderpest were immune for life.

384. By this time the Nigerian Veterinary Service had on its staff officers with experience of the research that had been undertaken amongst cattle bred by Europeans in the highlands of East Africa. When it was observed, as a result of extensive surveys amongst West African

cattle owners, that the incidence of cattle plague was similar in every respect to that obtaining in Kenya, it was decided to make use of the knowledge obtained over many years scientific research in the settled areas of Kenya. Further staff trained in Kenya methods were transferred to Nigeria, and methods of the control and eradication of cattle plague in Nigeria were commenced.

385. The Director of Veterinary Services describes the present position in Nigeria in his Annual Report for 1937. " The security afforded by the lifelong immunity against rinderpest which the sero-virus inoculation gives is now encouraging cattle owners to cull their inferior stock, and, by selective breeding, to build up improved herds. As far as Nigeria is concerned, where the ownership of cattle is entirely in the hands of natives, there can be no question that before any policy of stock improvement could be successfully advanced it was necessary first of all to bring rinderpest under effective control. Any other policy would have resulted in failure. Every year large numbers of cattle are being brought to the veterinary camps for rinderpest immunisation, and although the number done this year (411,651) was in excess of last year by 29,000 yet many more would have been done had the supplies of serum been adequate."

386. The driving force behind rinderpest control amongst these pastoral people is shifting, if it has not already shifted, from Government to stockowners. I was very much impressed by the complaints made by representative Fulani and Hausa to the Members of Parliament. They complained of the inadequate numbers of staff and quantities of materials for dealing with rinderpest. In my opinion no better tribute could be paid to the method used and the staff who apply it.

387. The application of the Nigerian method of dealing with rinderpest is confined to pastoral tribes of Northern Nigeria. There is no veterinary staff in Southern Nigeria.

Gold Coast

388. Rinderpest control on modern lines was commenced nine years ago. Prior to that cattle improvement schemes were in progress, but subsequent to the annihilation of one of the finest herds of improved cattle at Laura it was decided to concentrate the entire resources of the Veterinary Service on anti-rinderpest immunisation. A scheme was inaugurated whereby rinderpest control and stock improvement went forward at the same pace. The scheme was made possible by a free grant of money from the Colonial Development Fund. Four years later the Director of Veterinary Services reported " The attitude of the chiefs and people is now one of complete confidence, and is evidenced by the fact that Northern Territories people are buying large numbers of cattle for breeding." The Governor of the Gold Coast visiting the Northern Territories at that time recorded that the " campaign has strengthened immeasurably the confidence and friendship of the people towards ourselves."

389. Cattle owners in the Gold Coast are not entirely dependent on live stock for their subsistence in the same way as purely pastoral people. Their attitude towards their stock is a more detached one. Well-to-do people, when possible, employ natives from the pastoral tribes to look after their cattle. The Government organisation for controlling rinderpest appears to have appealed to the Gold Coast cattle owners, who had watched their herds being decimated by the disease before veterinary assistance was available. I was informed by the Director of Veterinary Services that all adult cattle have been immunised, and his staff organise annual inoculations so that no young cattle grow to maturity without receiving a life immunity. I was very much impressed by the way cattle owners of the Dagomba Native Administration have approached the question of these annual inoculations of young stock. The collection of young stock at convenient centres for inoculation is organised by the native administration, who also construct the immunisation camps. In Eastern Dagomba an insurance scheme has been instituted to safeguard owners from loss during inoculations, when thousands of young cattle are congregated at each centre.

390. As can be realised, it took some years of patient endeavour on the part of administrative and veterinary officers before their suggestions were accepted by the native administrations, who realise that they are assuming financial responsibility. The insurance scheme mentioned above is operated by the native treasury. Owners willingly paid a shilling a head, and the initial venture in Eastern Dagomba appears to have been satisfactory to everyone

concerned ; 3,122 young cattle were immunised. £156 2s. od. was paid in for insurance premiums. £107 was paid out on claims, and £49 2s. od. is available to be carried forward to next year's account.

Sierra Leone

391. Rinderpest crossed the border from French Guinea in 1930, and gradually infected all the herds in Sierra Leone. In some of the villages it was not brought to official notice until all the cattle had died. By 1933 the fire had burnt itself out. In 1936 the Director of Agriculture estimated the cattle population at 85,000. In 1930 an effort that Government was making to cope with the position was abandoned. The world-wide financial depression had become acute, and money was not available. More recently a beginning has been possible to study local conditions, and in 1937 an officer from the Education Department in Tanganyika Territory was appointed to assist the Director of Agriculture to make proposals for starting a live-stock industry in Sierra Leone. When formulated these will doubtless embrace rinderpest control as an essential preliminary measure so far as cattle are concerned.

Gambia

392. The same wave of rinderpest that was responsible for the havoc amongst the cattle in Sierra Leone extended to our Gambia dependency. By 1933 the number of cattle was reduced by half. The Gambia Government, after discussion with the Government of Nigeria, submitted their problem to the Nigerian Veterinary Service. A scheme of anti-rinderpest immunisation was agreed to, and with the approval of both Governments the Director of Veterinary Services, Nigeria, assumed responsibility for the work. In this way it was possible to obtain the services of staff well trained and experienced in successful methods for the large-scale operations involved when dealing with rinderpest.

393. By a combination of tact in handling suspicious native owners, and meticulous care in the technique of immunisation, rinderpest control has been established at a very small cost to Government. The rate of expansion will depend on the financial provision available. Progress at present is very slow. A staff of one veterinary officer (who is on duty six months each year), one African assistant and six African inoculators have to manufacture all the anti-rinderpest serum they require, in addition to the work of organising large-scale inoculations and the responsibility of the technique of immunisation. The numbers of cattle immunised during the past three years are 1935-6, 1,800 head ; 1936-7, 11,690 head ; 1937-8, 8,626 head.

394. This rate of progress is uneconomical, as rinderpest continues to spread over large areas. Last year outbreaks occurred in three of the four provinces, with a known mortality of 2,000 in two of them. No figures are available for the other two outbreaks. Since the work of rinderpest immunisation was inaugurated the decline in cattle population has ceased, and a slowly developing upward trend has set in.

The Sociological Influences of Cattle Plague Control

395. Cattle play an important, perhaps the most important, part in the lives of African people, whether they are wholly pastoral or combine cattle keeping and agriculture. The latter class can be associated with magical beliefs and ceremonial rites by the chiefs responsible for the prosperity of their people. Amongst pastoral tribes, and in the areas where fusion between them and agriculturists is evident, cattle play a prominent part in primitive culture ; the affection, especially of the women, for their cattle is very real. An epidemic of cattle plague, sweeping away young stock that has formed part of the family, is a major calamity that arouses depths of feeling untouched by other misfortunes. The knowledge which places governments in a position completely to prevent such happenings has, therefore, a wide appeal, and the rendering of such a practical service creates an atmosphere of confidence that will develop into a civilising influence of value. The security thus assured by Government, especially in the Sudan areas of Nigeria, will inevitably cause this service to function as a central pivot for all pastoral peoples. The alternative of losses from uncontrolled cattle plague ensures this amongst purely pastoral peoples indifferent to other influences. The prejudices and fears of the pastoral tribes in the Sudan areas of Nigeria and the Gold Coast have been overcome. The service that has gained their confidence will be listened to on all important questions

affecting their welfare, pasture conservation and development of water supplies ranking as of first importance towards improved live stock. Those of us who have spent many years amongst African tribes know how their social and other customs aim at assisting in the vital necessities of life. As these vital processes alter, such as the vanishing fear of cattle plague epidemics, so will their cultural and material outlook alter to accept ideas and practice which will be recognised as tending to greater security and comfort. The important thing to remember in thinking of these problems is that the average pastoral native is quite unlettered and without education as we judge education. On the other hand their minds are uncluttered by much useless knowledge that western peoples acquire in cinemas and similar institutions ; their sense of values is therefore more practical for their conditions. This was very apparent once the life immunity to cattle plague was demonstrated by the veterinary service.

CHAPTER VI

396. It is not intended in this Report to discuss at any length details of the various diseases requiring attention on the part of stockbreeders ; diseases that would be a matter of local concern, and which would not present any insuperable difficulties for efficient control. It is hoped, however, that the major conditions which affect the live-stock industry over those areas of country not suitable to any other form of production will be set out sufficiently clearly to indicate that unless measures for the control and eradication of cattle plague and contagious bovine pleuro-pneumonia are applied by a well-trained experienced staff all other efforts to improve the conditions under which these pastoral people live must result in failure. This aspect of live-stock conditions on the pastoral areas of Africa north of the equator must be grasped and firmly realised by everyone concerned in the future of the African peoples. Live-stock production by African natives has usually been considered by responsible people, both in Africa and at home, in an atmosphere created in agricultural areas where cattle have been allowed to multiply against the best interests of the soil. It is very important that the needs of the pastoralists who inhabit such large areas of Africa north of the equator should not be considered in an atmosphere of that kind. The owners of cattle to the number of many millions supported on these vast areas of dry country are leaning on the support which they now know they can obtain from western civilisation and science. This comparatively new attitude towards things which they have, hitherto, been unable to understand was made abundantly clear to me as I travelled amongst the stock-owning peoples who support themselves entirely by their animal industry. The conditions necessary for the preservation of the health of their animals over the territories administered by the British and French Governments between Lake Chad and Senegal are no longer a closed book to veterinary science. Beginning with the experimental research work which was made possible in the settled areas on the highlands of East Africa, and culminating in the control of cattle plague, so eagerly asked for by the peoples of the Sudan areas of Northern Nigeria, the application of veterinary science is now well understood. During recent years conferences on the question of cattle plague control have been held jointly by the administration of different territories under British control in which representatives of French and Belgian administration in Africa have joined. Live-stock diseases do not recognise any frontiers. The results of these discussions always pointed to the necessity for combined action in the different territories. Now when the willing co-operation of the pastoral African tribes is offered as a result of their experiences of the efficiency of veterinary measures, there remain only two outstanding questions of major importance for discussion and settlement. The first is the provision of laboratory products and trained veterinary personnel. The second concerns payment by the African owners for the services rendered. The biological products and the type of training necessary for personnel are common to all the territories, but the laboratories for manufacturing the biological products and the facilities for training personnel vary to a wide degree in each territory. In my experience—and in this Monsieur Curasson, the Director-General of French Colonial Veterinary Services, agrees—the most potent biological products for cattle plague immunisation amongst zebu cattle are obtained from cattle of exotic blood. The standardisation for potency of all products used for this purpose is essential. In the past, serious mistakes have occurred before an efficient technique for this purpose was available. Cost of production is a most important aspect when the large amounts required are considered. The availability of suitable cattle, therefore, and healthy conditions for the laboratory personnel, are the chief features governing economic production

of biological products for cattle plague immunisation. Modern conditions of transport will allow of the manufacture of all the products required at a central institute. If such an institute is situated in a locality which combines all three factors, great economy in production can be assured : an adequate supply of suitable cattle, facilities for testing the potency of the products produced, and healthy conditions for the workers.

CHAPTER VII

NOTES ON GAME PRESERVATION IN THE WEST AFRICAN DEPENDENCIES

397. Before discussing the position with regard to the preservation of the wild fauna of West Africa it is useful, perhaps " essential " is the better word, to survey very briefly what has happened to the game animals in other parts of Africa.

398. Before the Boer War it was possible to shoot big game animals in Cape Colony and the Transvaal. In those parts of Africa the herds of antelope that provided the voortrekker with meat have given place to cattle and sheep on the pastures, and predatory animals have been driven farther north. At the present time big game animals are found sharing the pastures of the pastoral natives in East and North-East Africa, where the elephant and the buffalo have an abiding home in the forest areas. Hippopotami are still plentiful in the tropical rivers and lakes in those parts of Africa, and lion, leopard, cheetah and wild dogs are still to be found in numbers where their natural food, the game animals, abound.

399. The fact that large numbers of game animals still survive in those parts of Africa is due to two things ; in the first place the pastoral people that live amongst them do not carry fire-arms and are not short of meat, and, secondly, large areas of country have been reserved as breeding grounds where shooting of any kind is prohibited. The position, however, is not static. The economic development of some areas and the increase in numbers of predatory animals in other areas are factors calling for consideration to-day.

400. With this very brief survey in mind the position of game animals in West Africa can be more easily examined. The fact that efficient game preservation in West Africa has not been possible in the past is evident in the very small numbers of any local species to be found there to-day. Game laws are in evidence. There are hunters' guilds, the members of which support themselves and their families, using old-fashioned black-powdered guns. The importation figures for black powder at Lagos and Accra could indicate the number of these guns in use.

401. Before forming an opinion on the game laws in West Africa that could assist by constructive criticism, it helps towards the adjustment of a sense of proportion if the difficulties of game preservation in civilised countries not so many years ago are considered at the same time.

402. In my opinion the future of game preservation in West Africa does not lie in a system of ordinances and regulations copied from other countries. I would suggest that the confidence of the members of the hunters' guilds be obtained, and the advantages of some kind of system and order in the management of game areas be explained to the African hunter-guild members. If the advice given is sound it will lead to a steady increase in the numbers of animals available. Africans of the hunter guild whom I spoke to would not be slow to grasp the meaning of a policy of this kind. Such a policy could also react favourably on the numerous game birds of the country, especially in those areas within reach of the large towns where local game preservation societies would do much to unite in a common purpose the sporting proclivities of the well-to-do African. In this way species which are almost extinct can be saved and game would return to areas where it is unobtainable to-day.

403. The following suggestions are put forward to assist in consideration of these questions by persons interested in game preservation in West Africa :—

(i) Confine game preservation efforts to forest reserves and other large unfarmed areas. Abandon the rest of the country.

(ii) Resuscitate the old native hunting laws, strengthen the hunting guilds where they exist, and give official backing to the hunting chiefs. Allow no stranger, European or native, to hunt without a regional licence as well as a game licence, and make the native rightholders gamekeepers by giving them Government support for keeping their hunting rights exclusive. In the few areas where native hunting rights have been extinguished, and with such special cases as the manatee, issue a few exclusive licences, with a fee so heavy and a penalty (of losing licence and gear) so rigidly enforced, in the few cases where it is possible to discover that the terms of a licence have been broken, that the licensee will consider the privilege and profit far too valuable to risk its loss by tolerating poachers, even when he is only subject to the slightest supervision.

(iii) In the hunting areas try to obtain small inviolate breeding sanctuaries or " reservoirs " on the principle explained in the *Nigerian Field.*

(iv) Make the Forestry Department alone responsible for carrying out game preservation work, so that Government can fix responsibility and direct policy.

(v) Try to work with the existing machinery of Government, native law and custom, and therefore without additional expense. The game of Nigeria cannot as conditions are at present, and probably can never, make orthodox and expensive preservation measures a " business proposition."

POSTSCRIPT

404. The foregoing chapters of this Report were written in 1939 prior to the outbreak of war, which has involved all the territories under consideration. At the present time it would appear that the production of food is of greater importance than international boundaries in Africa north of the equator. Africa north of the equator may be roughly divided into six natural regions :—

(i) The Mediterranean region, producing olives, figs, vines and, in some fertile areas, cereals. The rainfall in this area, as in Southern Europe, is practically confined to the winter and spring.

(ii) The Sahara region, which, except in a few specially favoured places, is almost rainless, and in which the pastoral wealth is limited to camels.

(iii) The Sudan region, which admits of both pasture and agriculture, but is mainly pastoral, with the ruling Hamitic race being devoted to cattle rearing, while the Negro people engage in cultivation where conditions of rainfall admit.

(iv) The Nile Valley, which forms naturally a separate region depending for moisture on the annual inundation of the river, and its resources are almost entirely agricultural.

(v) Western Equatorial Africa, with its intense humidity and even heat, is the home of the pure Negro. The high, even temperature and the constant rain make it a region of dense forest and tangled undergrowth ; amongst its most valuable crops are the oil palm, the banana, and various rubber-producing creepers.

(vi) The Great Eastern Plateau, consisting largely of the extension of savannah grass country into which the Hamitic nomads expanded southwards, and where, under Negro cultivation, suitable localities produced large crops of various food plants, and Europeans have introduced coffee, sisal, dairying breeds of cattle, and wool-bearing sheep.

405. This very brief general statement can serve to bring on to one canvas a picture of the Hamitic pastoral peoples (with whom this Report is chiefly concerned), living under similar conditions, employing common methods of pastoral live-stock husbandry, although they are divided into widely separated communities such as the Fulani in the west, Bahima in the centre, and Masai in the east. My journey as live-stock adviser to the Leverhulme Commission gave me the opportunity to bring all the details of the animal husbandry common to the areas between Lake Chad and Senegal under review in the light of the experience gained amongst the Masai, Samburu, Somali and other pastoral peoples in Central and North Eastern Africa.

406. The decisive factor in the lives of all those pastoral people is the very heavy recurrent wastage of their live stock from cattle plague, the same disease which made cattle production impossible in Europe until it was exterminated towards the end of last century. This disease

is enzootic in all the African territories north of the equator. Under natural conditions it causes the death of approximately 60 per cent of the annual increase in cattle. In Chapter V of this Report the struggle between veterinary science and cattle plague under African conditions is described. It will be noted that little progress was made in evolving measures against it (the slaughter method eradicated the disease from European countries) until the herds of cattle bred by the settlers in the highlands of East Africa were available to test experimental methods of immunisation. After some years of trial and error it was possible for the veterinary staff engaged in the work to establish a method capable of general application to native-owned herds which would give a satisfactory life immunity against the disease. The following extract from the annual report for the year 1925, in which the Chief Veterinary Officer, Kenya, discusses the application of veterinary science to the work of eradicating cattle plague, is of interest, as this work was subsequently extended to the pastoral peoples of the Sudan areas of West Africa :—

> The conservatism of primitive pastoral peoples and their blind adherence to the cattle husbandry of their forefathers, which has handed down to them all the live stock they possess, can easily be understood by any student of the African native. This inherited cattle husbandry has for its keystone immunity from the disease naturally acquired. The price paid for this immunity (acquired at the expense of approximately 60 per cent of mortality of infected stock) is a heavy one, but the native understands it. In my last annual report I reported on the first stage of an educational system I had introduced with the object of demonstrating to natives the cheaper method of obtaining immunity to cattle plague.
>
> The success of this system is largely due to the Officers and Stock Inspectors, who have spared no efforts to overcome the difficulties that are inevitable in the initial stages of such work amongst primitive natives. (Annual Report C.V.O., Kenya, 1925, pages 44 and 51.)

407. The successful completion of the research work in Kenya was in a great measure determined by the helpful co-operation of the stockowners in the settled areas of the highlands. Before final success was achieved, losses which could not be covered by compensation were inevitable. The experience gained as a result of the mistakes made was the decisive factor in the ultimate success. The position in this respect was described by Mr. J. Walker, Chief Veterinary Research Officer (Kenya), at the Eleventh International Veterinary Congress in 1930. Mr. Walker was able to report " In 1925 a rinderpest field service was instituted in Kenya, a high standard of efficiency in the control of the process of immunisation had been sought, and imperfections in the method had been detected."

408. Following on the transfer of veterinary personnel trained in the method in Kenya, the new technique of rinderpest immunisation proved equally successful amongst the Fulani herds in West Africa. During my visit Fulani cattle were being immunised at the rate of approximately half a million a year. I discussed the method among stockowners, including the Emir of Zaria, the Emir of Katsina, and the Sultan of Sokoto, all of whom expressed satisfaction at the results achieved.

409. Veterinary science has now provided a method which can eradicate cattle plague from Africa, replacing the slaughter policy by which the disease was dealt with in Europe. But the substitution of one efficient technique for another does not mean that any of the other items in the European system of eradication can be dispensed with. Cattle plague knows no boundaries. Agreement therefore by all the governments concerned for the adoption of a common policy is vital.

410. The governments concerned in Africa north of the equator cannot remain disinterested in the needs of the post-war world for vital food supplies. They have under their several administrations large areas of pasture lands unsuited climatically for tillage crops, but which produce animal protein in abundance. (At least 60 per cent of the annual production is lost from enzootic cattle plague.) The needs of the pastoral peoples for more exports to exchange for goods which they cannot produce is also evident.

411. A post-war policy which would deal efficiently with cattle plague would answer both these questions. A policy that will bring these two forces into closer communion will be for the common good of all.

412. It is not venturing into the realms of prophecy to state that the world's meat production will be short of requirements for years after the war. Immense stocks of wheat are accumulating in America (North and South) and Australia. Rigid price control of the commodity must continue or prices will soar when large movements of stocks begin.

413. In the matter of meat the situation will be entirely different, as there are no reserves to draw upon.

414. It is of interest to note that the Canadian Bureau of Statistics estimates the average peace-time consumption of meat in that dominion as from 35 to 40 ounces per week. This is approximately equal to the peace-time consumption in U.S.A., England and Germany, about 50 per cent above similar figures for France, Holland, Belgium, and over three times greater than Italy. In most of these countries meat rationing is now in effect. The U.S.A. Office of War Information indicates that whereas they have a voluntary allowance of 40 ounces the average meat ration has been elsewhere reduced to 31 ounces in England, $12\frac{1}{4}$ ounces in Germany, 9 ounces in France, $10\frac{1}{4}$ ounces in Holland, and 5 ounces each in Belgium and Italy.

415. Unlike wheat, there are no supplies of meat in sight to suggest that these averages can be considerably increased for a number of years after the war.

416. Along this line of reasoning, based on the information at present available, careful planning to use with skill and foresight the different varieties of natural pastures, and bring to a high state of production the existing flocks and herds, would ensure the maximum supplies of protein food which are bound to be in short supply. Who will give the lead for the ten million cattle on the open pastures in Africa north of the equator ?

ACKNOWLEDGMENTS

417. I wish to acknowledge my gratitude to the officials of the Government Departments and the staffs of the companies trading in West Africa for much valuable information and useful help during my tour. I am indebted to Captain J. L. Stewart, M.C., M.R.C.V.S., Director of Veterinary Services, Gold Coast, and to Mr. L. H. Saunders, Agricultural Superintendent, Gambia, for their kind permission to use photographs of Gambian and Gold Coast live stock.

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